



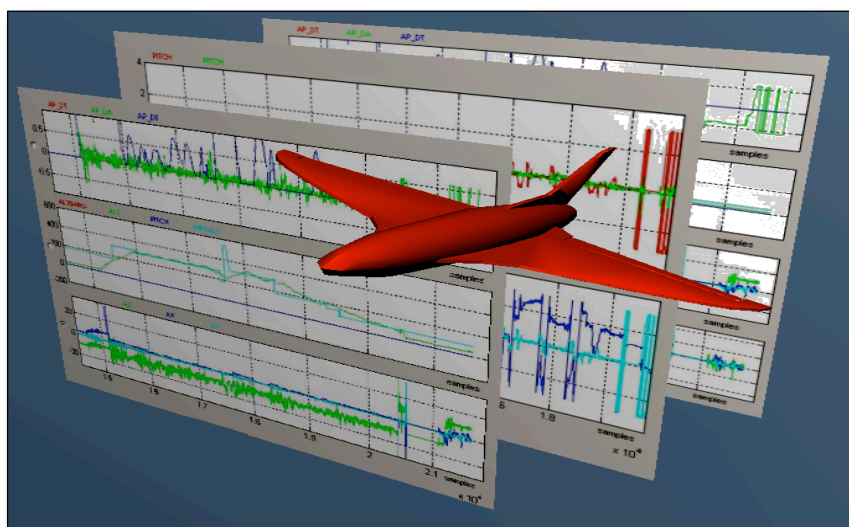
## Lynx 2

### The UAV Navigation Technical Debrief User Manual

PATH:\development\products\Lynx\doc>manuals

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**UAV Navigation S.L.**  
C/ La Granja, 74  
28100 Alcobendas Madrid.  
ESPAÑA  
CIF B84025840  
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#### LEGAL DISCLAIMER AND END USER AGREEMENT

The purchaser of Lynx UAV Navigation Technical Debriefer (from hereon **USER**) is the end user for this software and will not sell it, loan it, lend it or allow it to be used by third parties in any shape or form.

**USER** will use this software lawfully and abiding all local regulation for the operation of computers on which Lynx is installed.

**USER** will not use this software in any military or defense related application (including observation).

**USER** clears UAV Navigation, S.L. of all responsibility and liability derived from the use of Lynx, even in the event of a failure of Lynx.

**USER** is responsible for abiding with this agreement and enforcing it to third parties that might come in to contact with the Lynx Data Reproduction Graphical System.

## 1. INTRODUCTION

Lynx 2.0 is UAV Navigation's ultimate software for data visualization. Lynx 2.0 receives and plots data recorded on a .uav data log files.

### 1.1. *Lynx overview*

Lynx provides graphs representing:

- All the variables recorded in a data log file.
- Multiple plots of the same flight with the same time axis and different vertical scale.
- Easy and intuitive mode of handling data plots.

Lynx introduces flight-recorded data directly from .uav files.

## 2. INSTALLATION AND OPERATION

### 2.1. *Installation of Lynx*

Lynx is already an executable file and it does not need any installation although Lynx uses the Java Virtual Machine that needs to be installed on the machine.

### 2.2. *Lynx trial version*

Lynx can be downloaded for free in a trial version from the UAV Navigation Help Desk website to use without license dongle.

#### **IMPORTANT NOTES:**

- This version will only allow a limited type of parameter plots
  - For the X axis only time or samples related parameters are available.
  - For the Y axis almost all autopilot variables can be plot, except some gps, guidance and alarms parameters.
- Also, every plot will have a UAV Navigation watermark on the background.
- All the functionality remaining is similar to the licensed version.

### 2.3. *Start debriefing*

First step is executing Lynx with the licensed dongle on the USB port. The initial interface is as simple as:



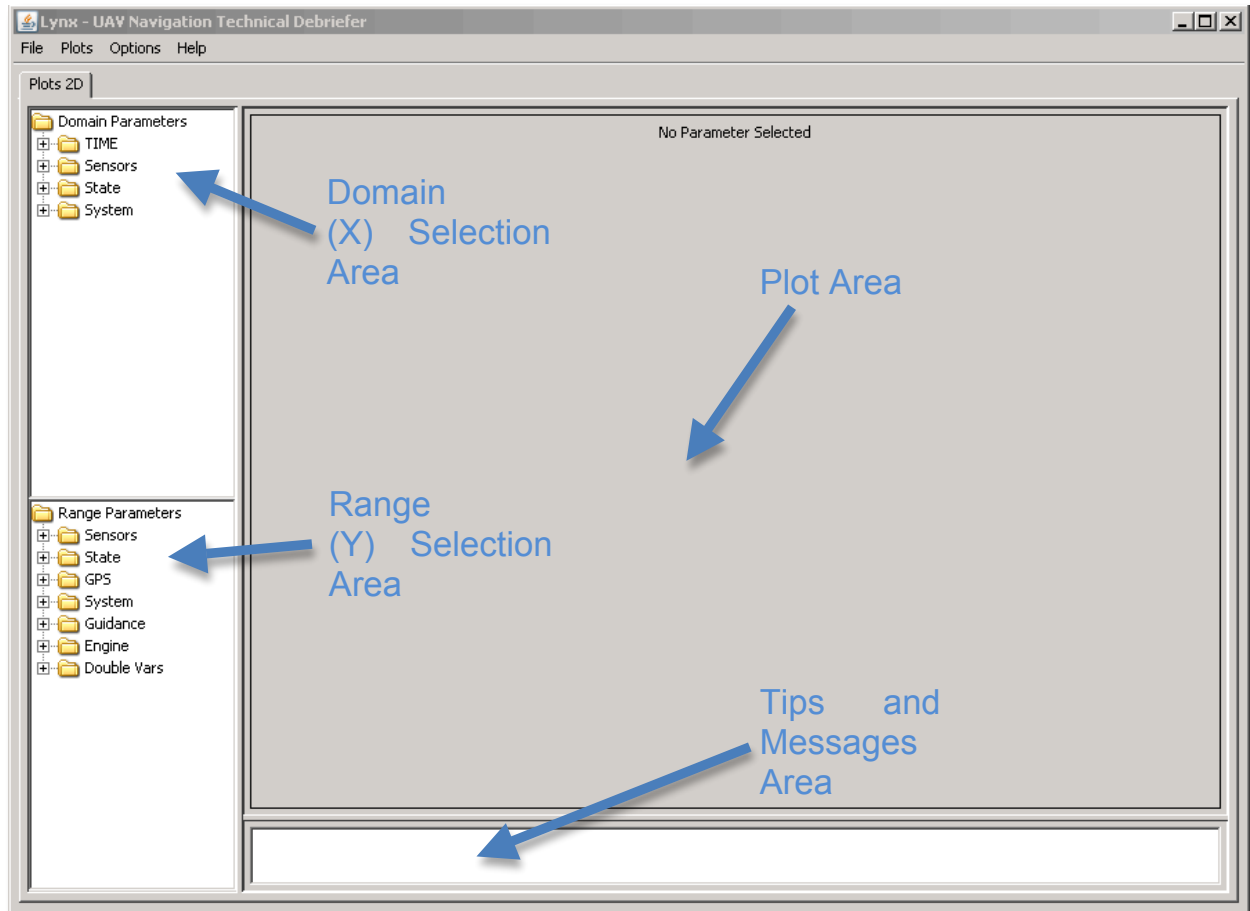


Figure 1

## 2.4. Studying data:

- This manual will show the procedure to study the log files through one example.
- The first step is to press on file menu on the application menu bar and open a file as in the picture:

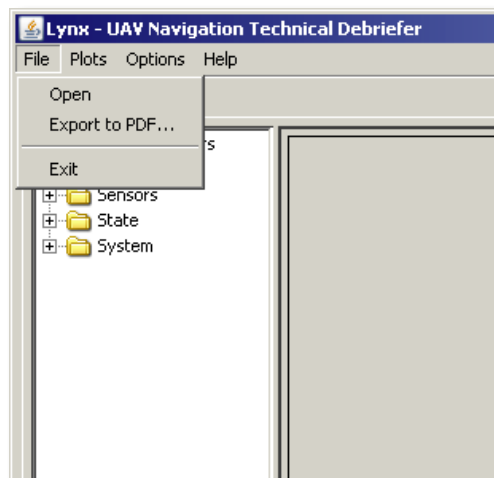


Figure 2

- An open file dialog opens with the .uav files shown on the selected folder.
- Click on the desired log file and press open.

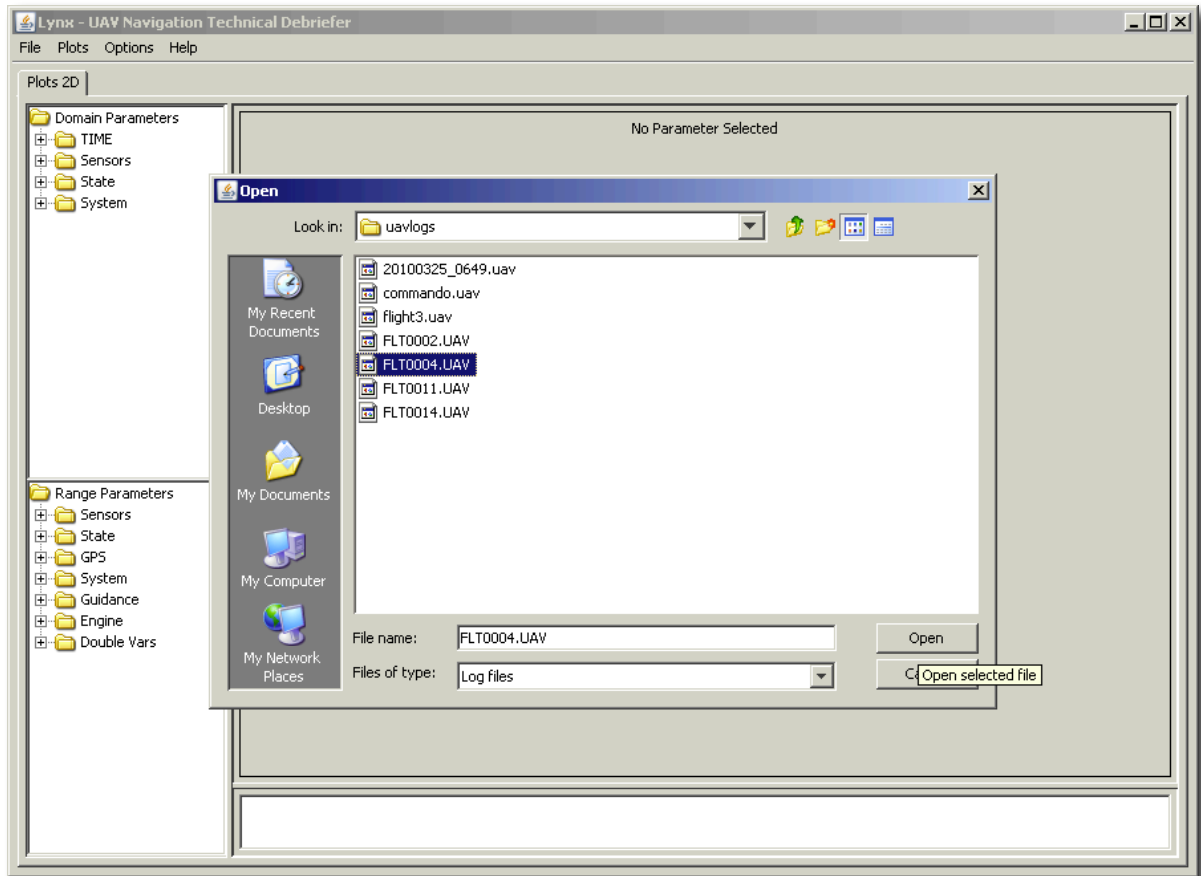


Figure 3

- We can press on the Range Parameters tree and start to look for the ones that could be interesting for our study.
- The parameters tree is created to simplify the search for a particular parameter. Looking for the accelerometer in the z axis, we open the **sensors** folder, then **IMU** (stands for Inertial measurement unit).
- Lynx will use samples as a default for the X axis if no domain parameter is selected before selecting a range parameter. If the intention is to use a different time or parameter for the X axis **it has to be selected before than the Y axis parameter.**
- Looking at the Domain Parameters area not only time related parameters appear, Lynx can cross any parameter you may choose from the log file.

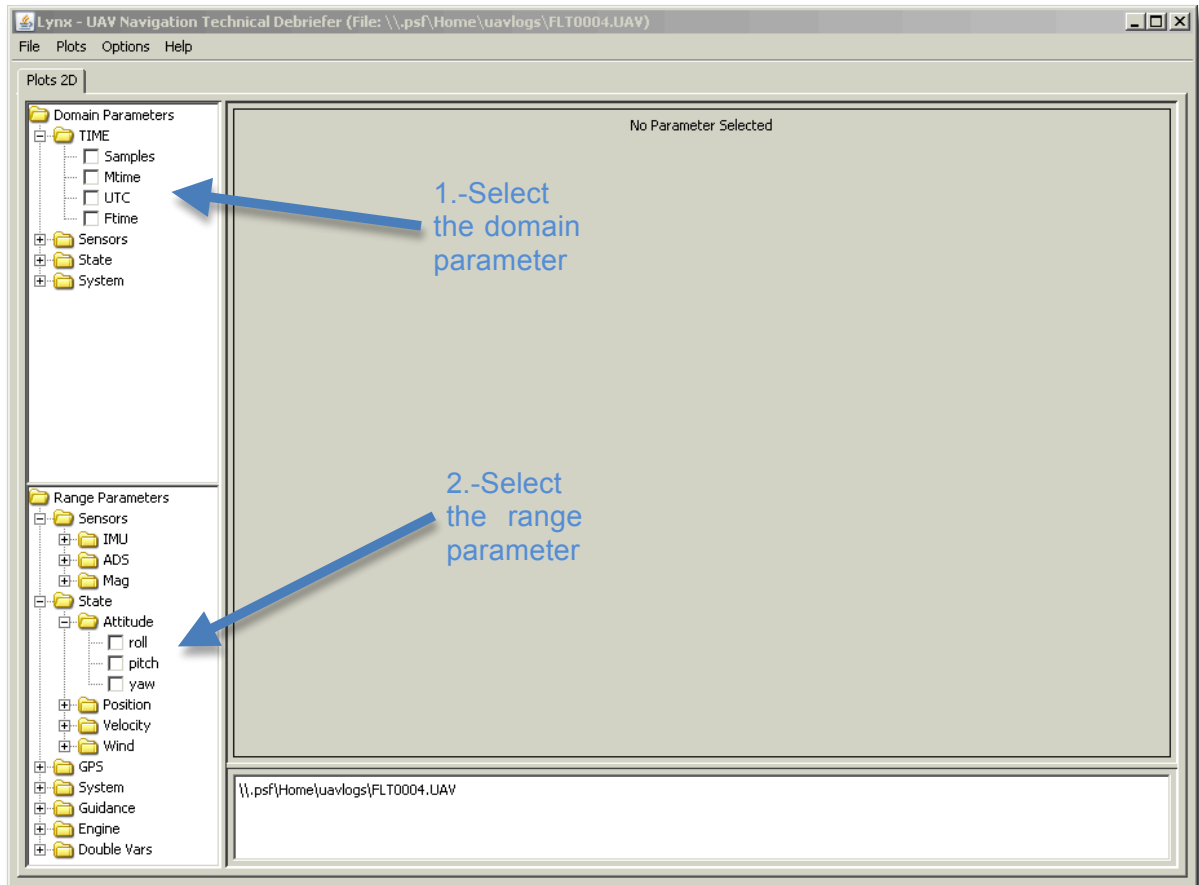


Figure 4

**NOTE:** Once the file is loaded its name is shown on the top of the application and on the tips and messages area

- Press on the checkbox of the parameter to study on the Range Parameters area (Y axis).
- Many parameters can be plotted on the same chart.
- Deselecting a checkbox will erase the plot from the chart.

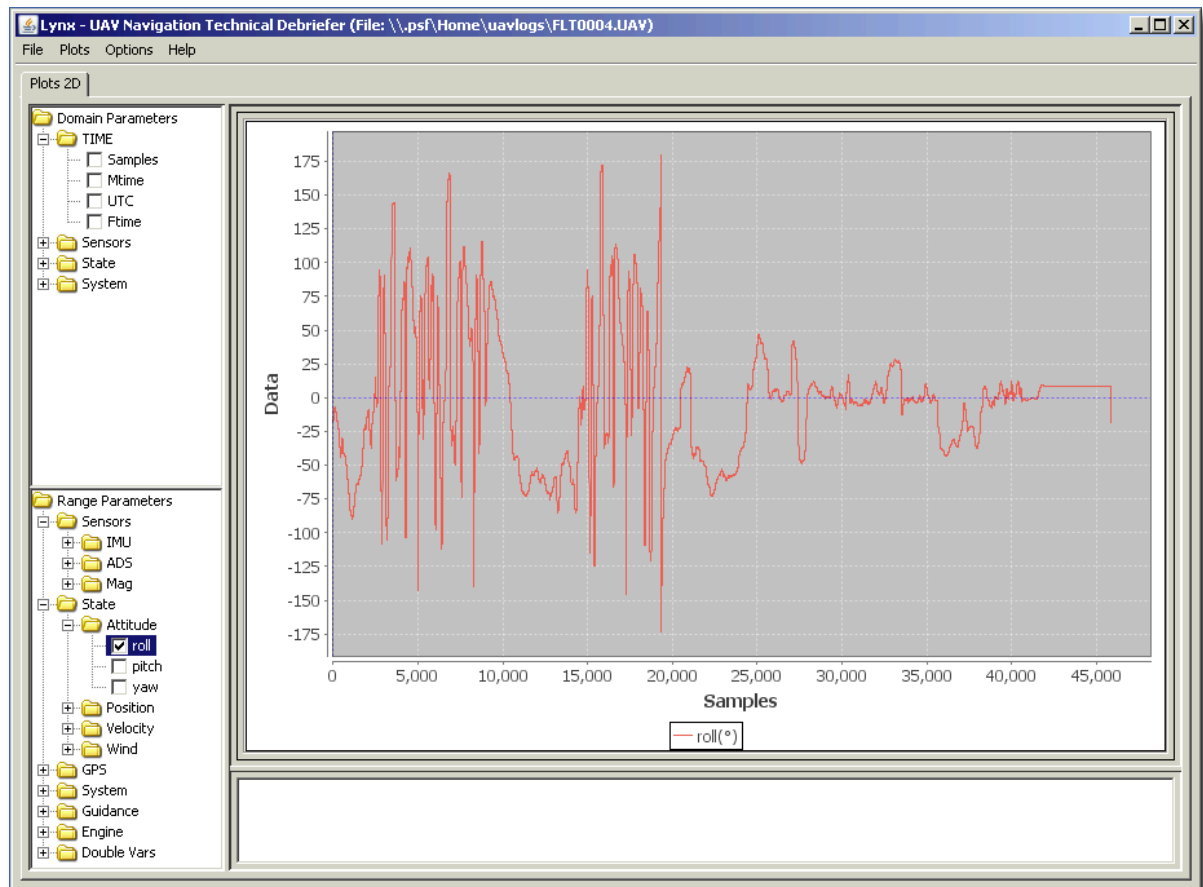


Figure 5

**NOTE:** that the X axis cannot be changed for the same chart.

- The first chart with the desired plot appears as soon as the checkbox is pressed. In this example the roll angle of an aerobatic aircraft is shown.
  - The curve plotted is always linked with a box under the chart that shows its name and units between parentheses.
  - The Y scale is shown on the left side not necessarily centered on zero.
  - The X scale is shown on the bottom part of the chart.
- The chart can be completed by, for example selecting **pitch** and **yaw** checkboxes. The curves will appear one by one as shown on the figure 6.
- For more accurate information a tool tip appears in the chart whenever the mouse pointer crosses one of the curves. This tooltip shows a complete description of the data (parameter, unit and (x,y) pair of values.
- In figure 7 the parameter **pitch** is deselected leaving the chart with **roll** and **yaw** curves and also another tooltip is shown on a different part of the plot.

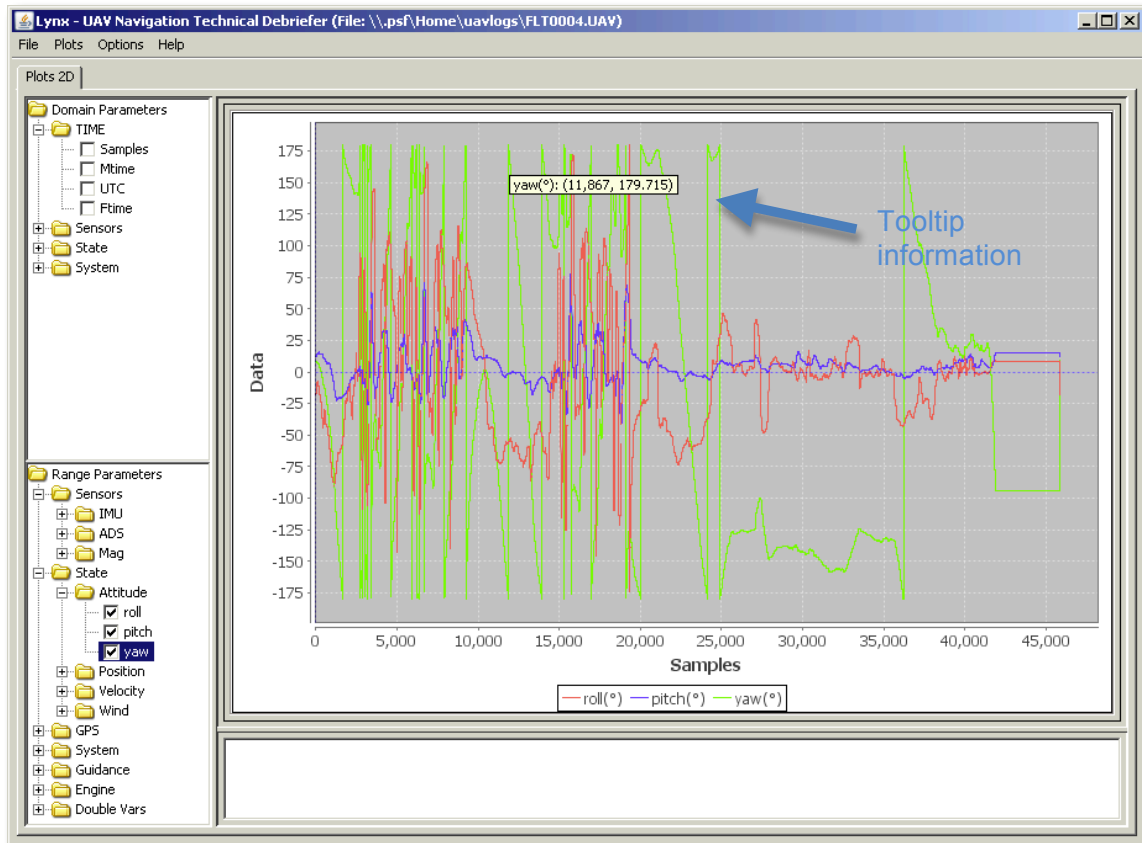


Figure 6

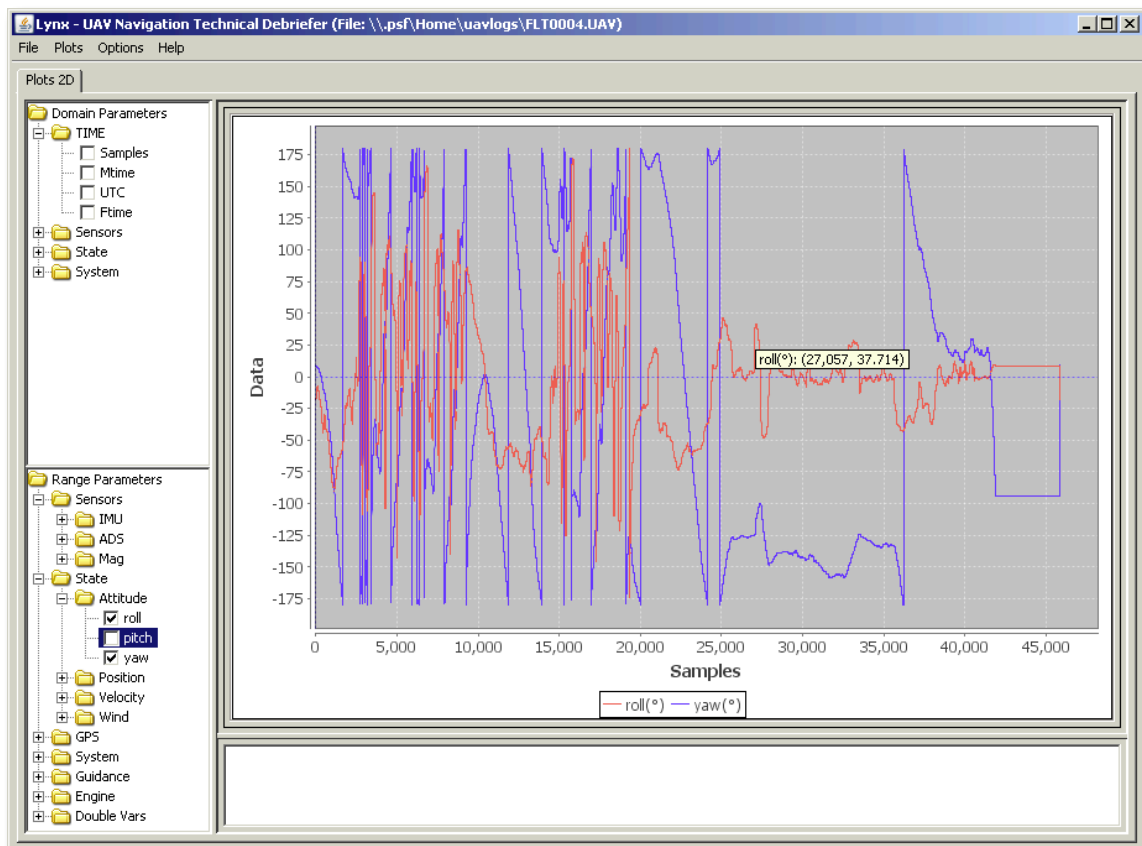


Figure 7

- Suppose the chart in figure 7 is interesting and we want to compare against other flight parameters of the log file, the chart can be kept in the next three ways:
  - Double click with the mouse left button anywhere on the **Plot Area** and the chart will be unleashed from the application with identical properties to a new independent frame.

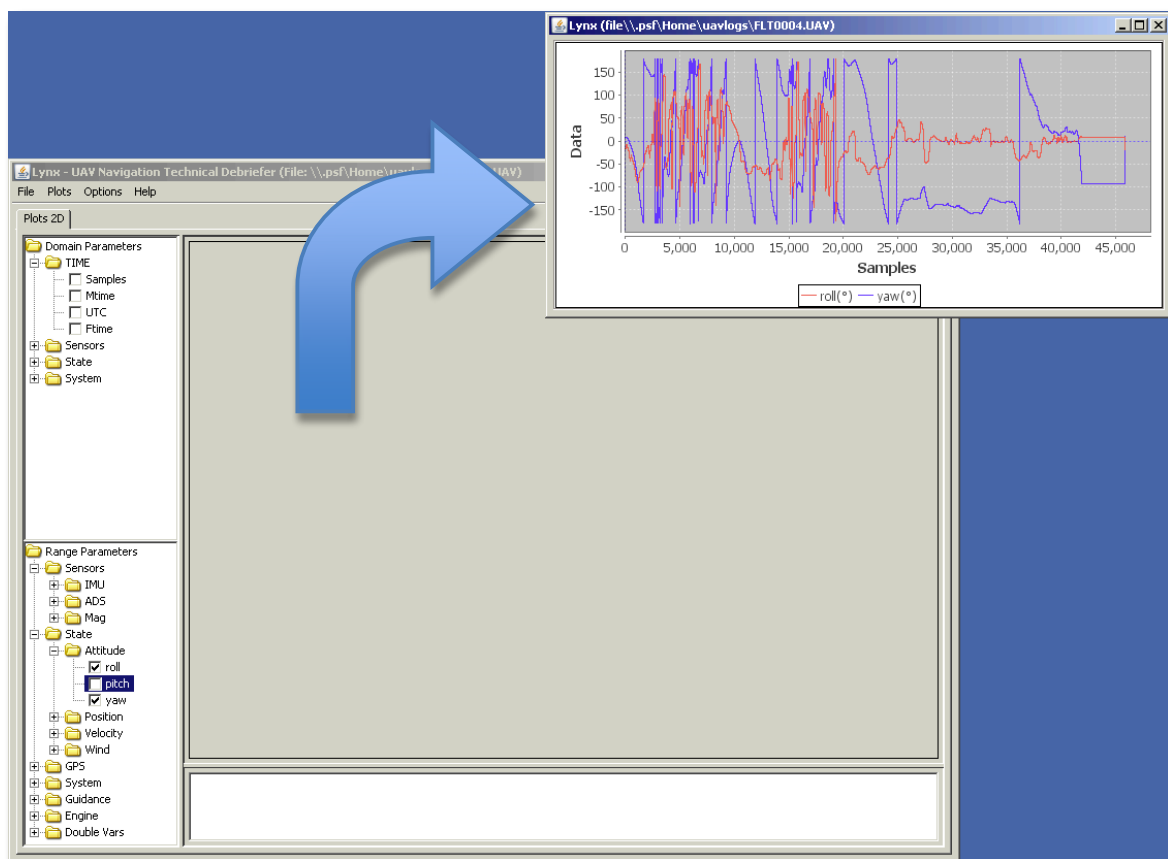


Figure 8

- On the File menu select Export to PDF; this will open a file dialog permitting the folder exploring and name selection.

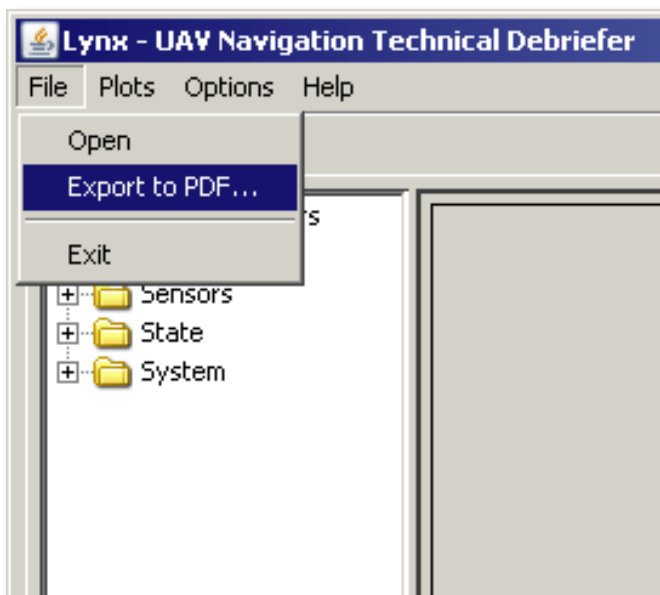


Figure 9

- Right click on mouse anywhere on the chart except over curves will open a pop-up menu with a **Save as...** option. This will be a png file save (stands for Portable Network Graphics) very suitable for plots file saving in lightweight.
- For the next chart suppose your desire is to compare between acceleration on the Z-axis of the aircraft and velocity. As a result the chart on figure 10 appears:

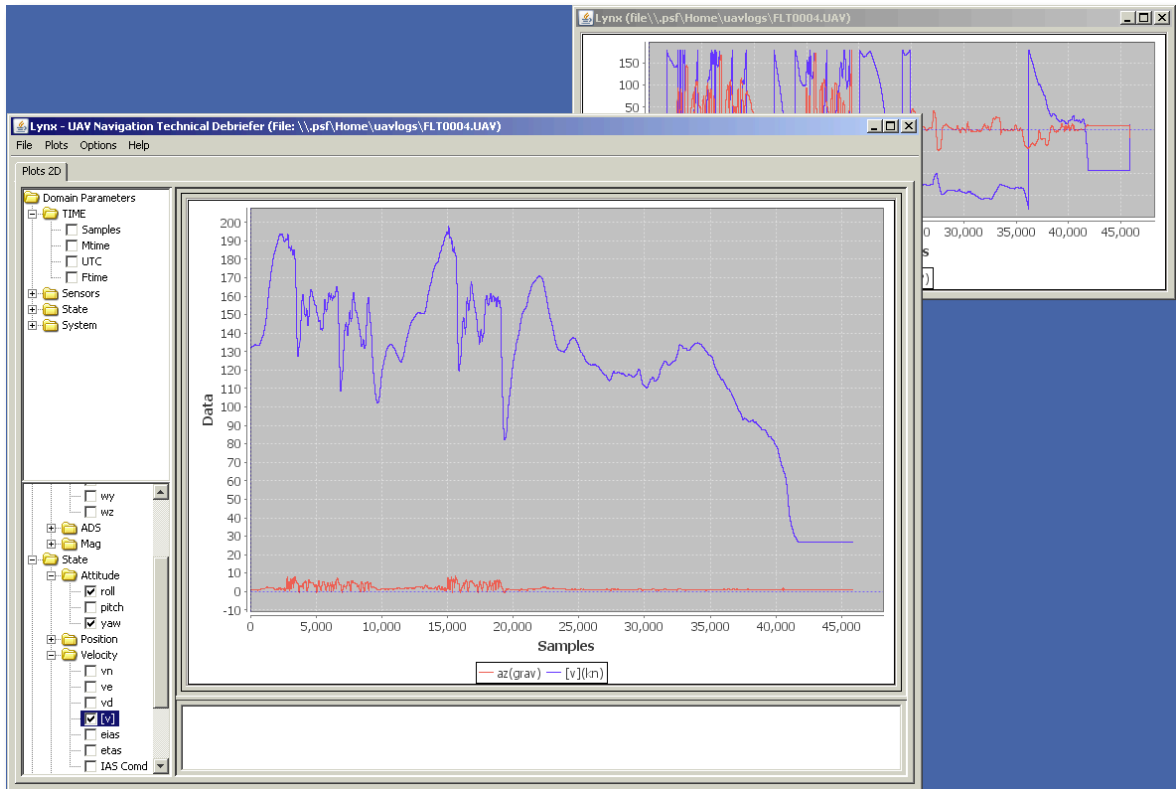


Figure 10

- The first thing to observe is the difference between scales, which makes it difficult to compare accurately. This issue can be solved **right clicking on the curve** you wish to change scale. A different pop-up menu than the one popping on the rest of the chart appears with one option with the text **Change Scale**, left clicking on that option will create the new scale and send that curve under it:

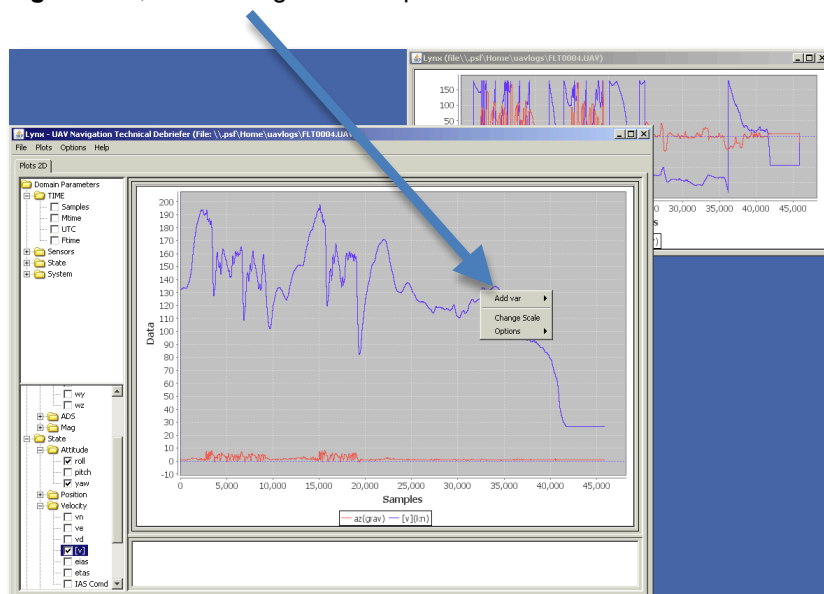


Figure 11

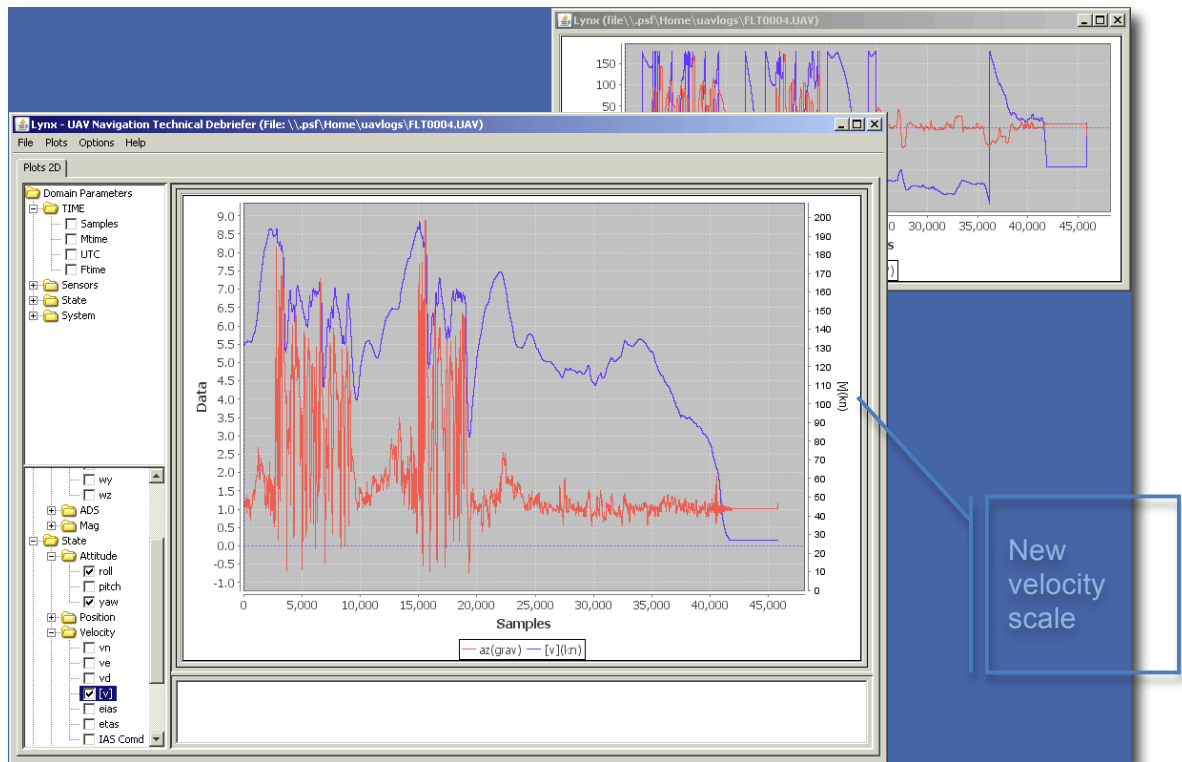


Figure 12

- Repeating the step to unleash the chart from the main frame both independent frames can be operated to make as easy as possible the study, side by side as in figure 13 or changing the size and position until reaching similar X axis scales as in figure 14:

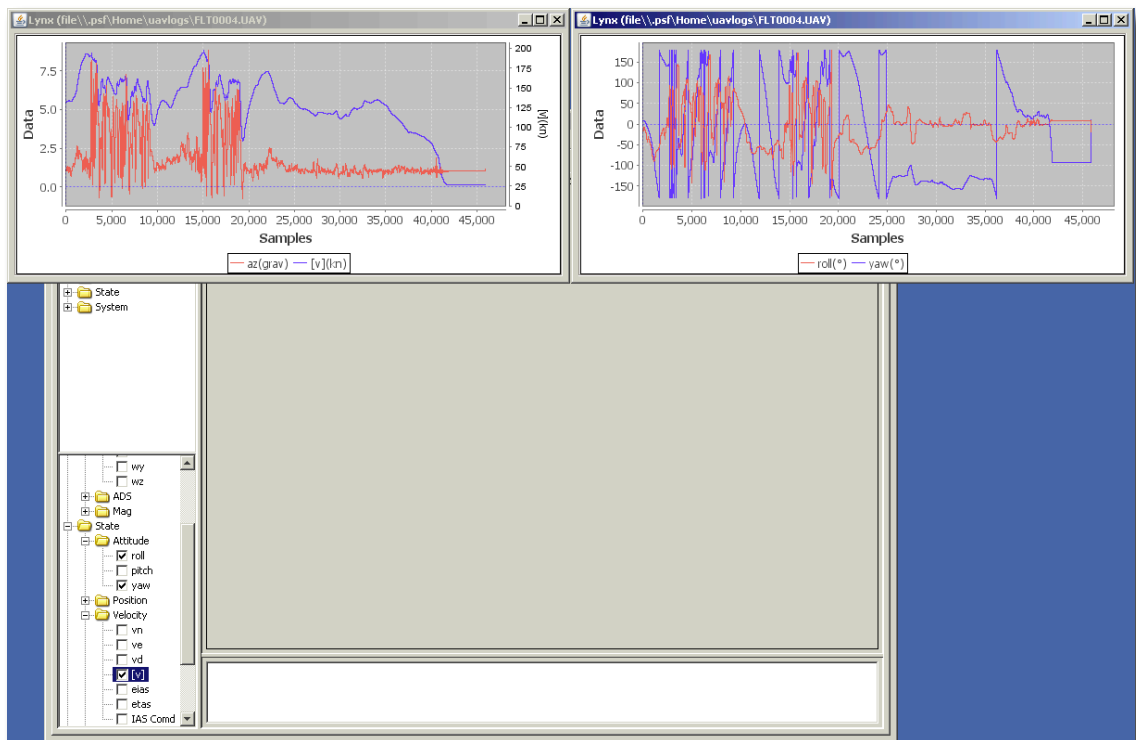


Figure 13



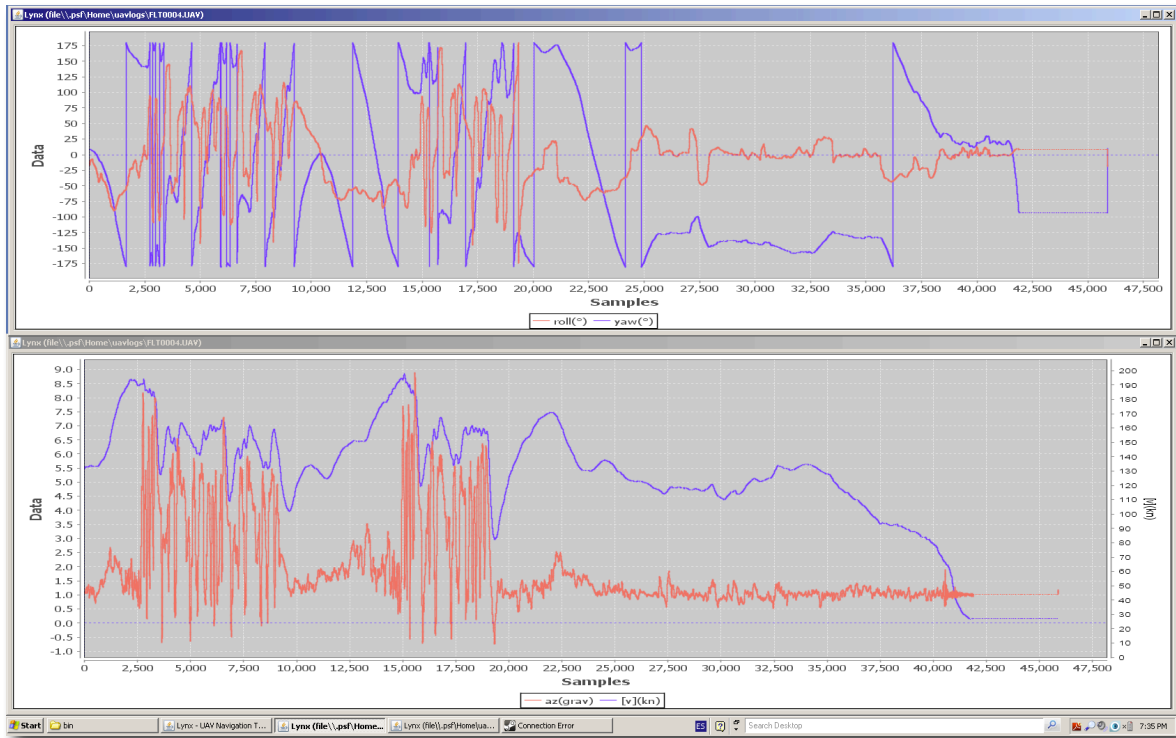


Figure 14

- The chart operation is really intuitive:
  - Zoom-in** sequence can be done at any moment by clicking the left button and dragging through the desired zone (which will be shadowed) from **top to bottom** and **left to right**:

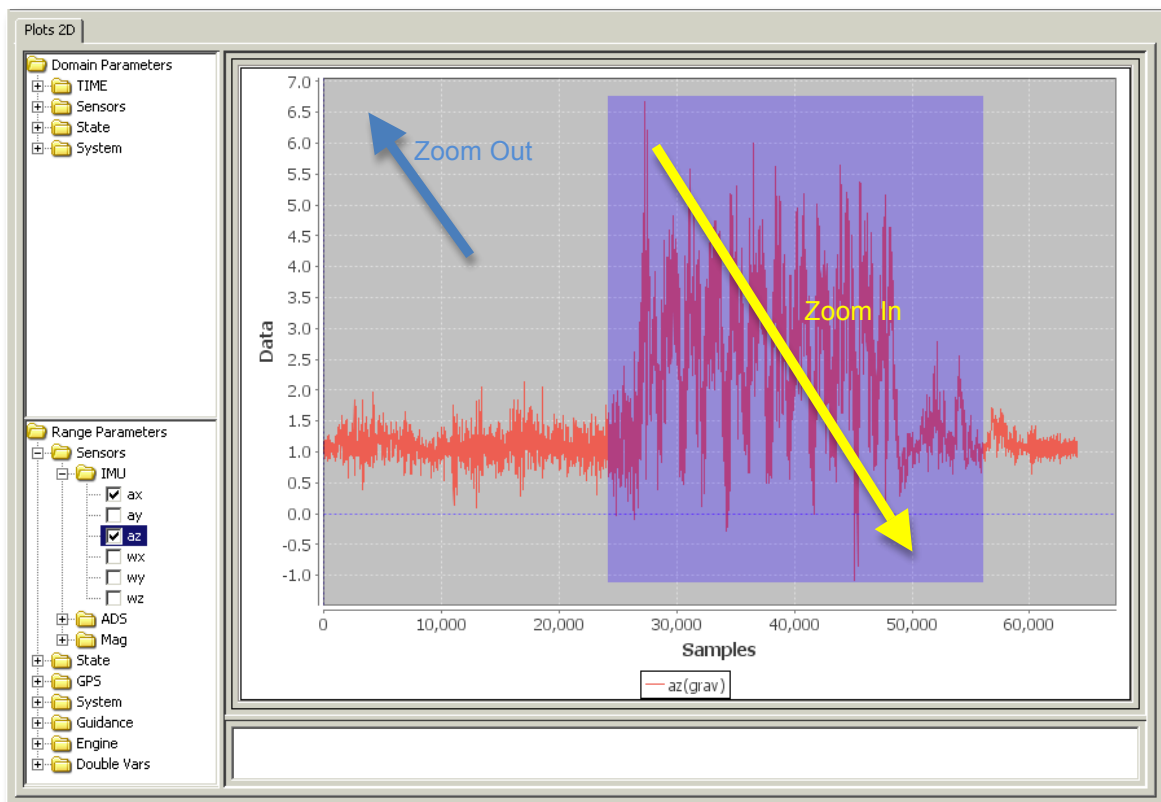


Figure 15

- **Zoom-out** sequence is the exact opposite in the mouse movement, from **bottom to top and right to left of the chart**. Actually this sequence will reset the plot to the starting point.
- **Mouse wheel** can be used also for zooming in and out, being the focus of the zoom the position of the mouse pointer on the chart.
- **Pop-up menu** has options to reset the chart to the start point (**AutoRange**) and to **zoom-in (out)** in the X axis, Y axis or both of them, as shown in figure 16:

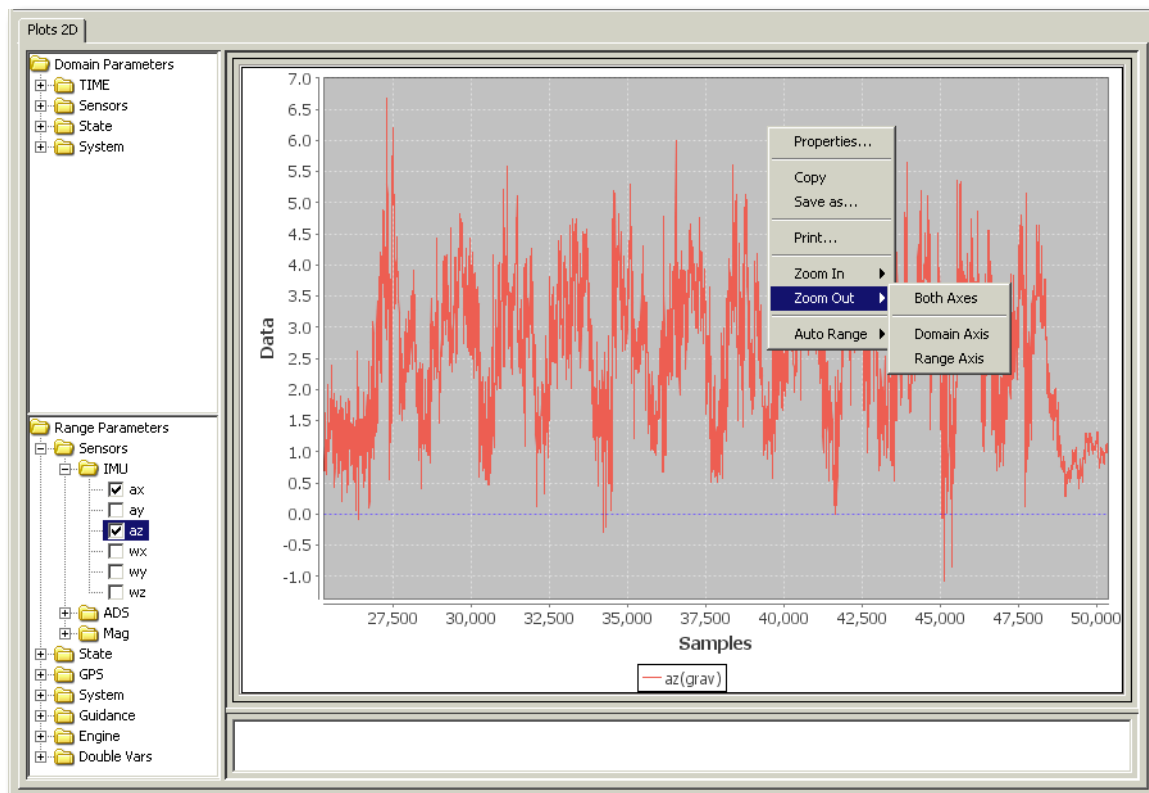


Figure 16

- **Properties** in the pop-up menu is used for the full customization of the chart:
  - As default the chart does not have a **title**, but for report generation is crucial to have one on each plot. On the properties dialog on the title tab we can select the **Show Title** tab.

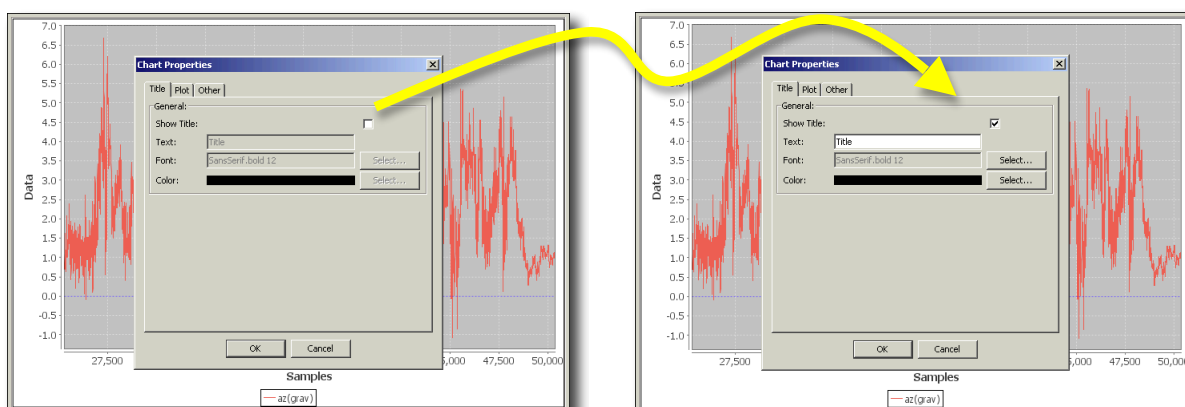


Figure 17

- The **font** and the **color** of the title can be changed easily with three different types of dialogues in figure 18:

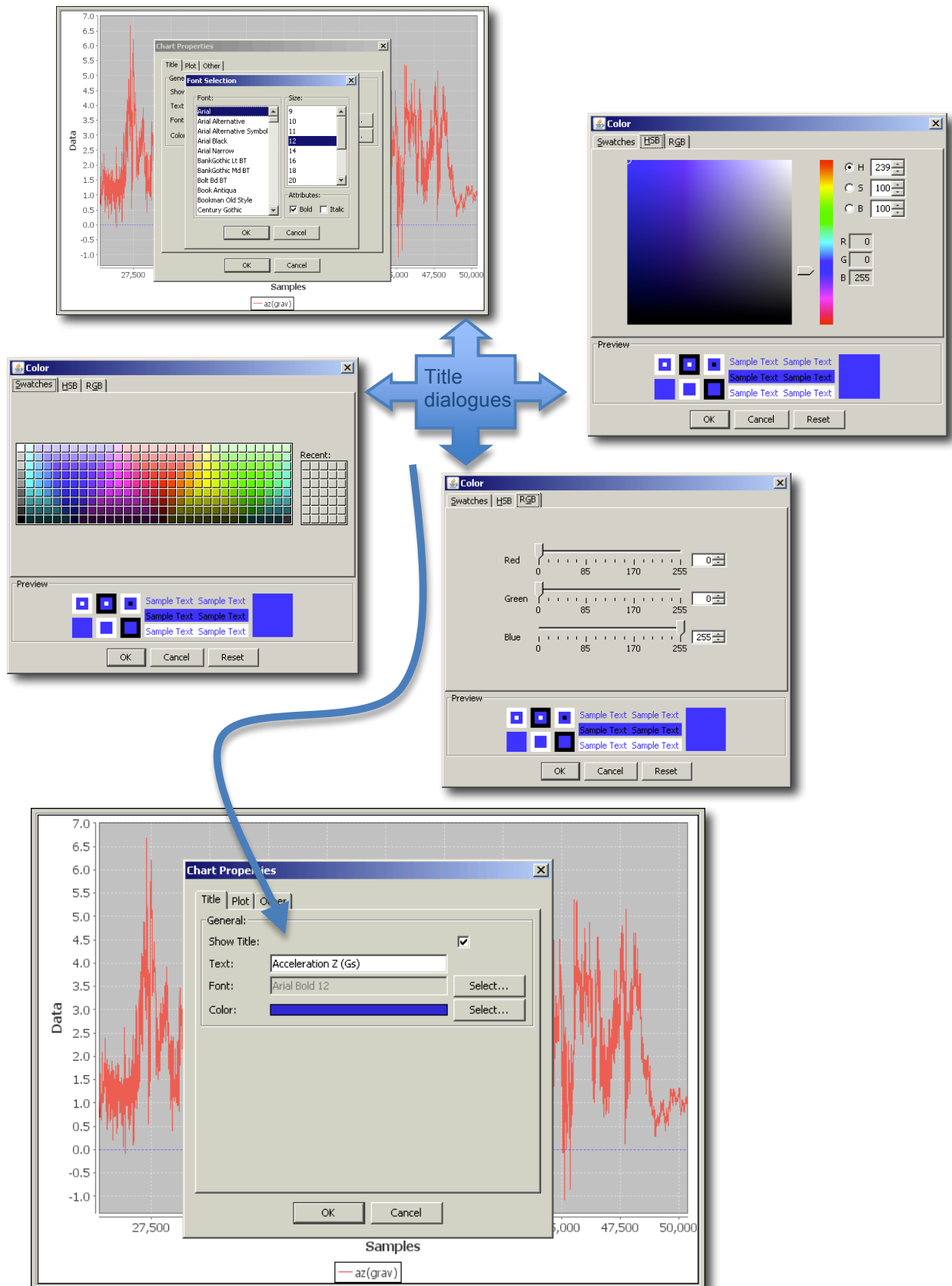


Figure 18

- To get the following chart with title:

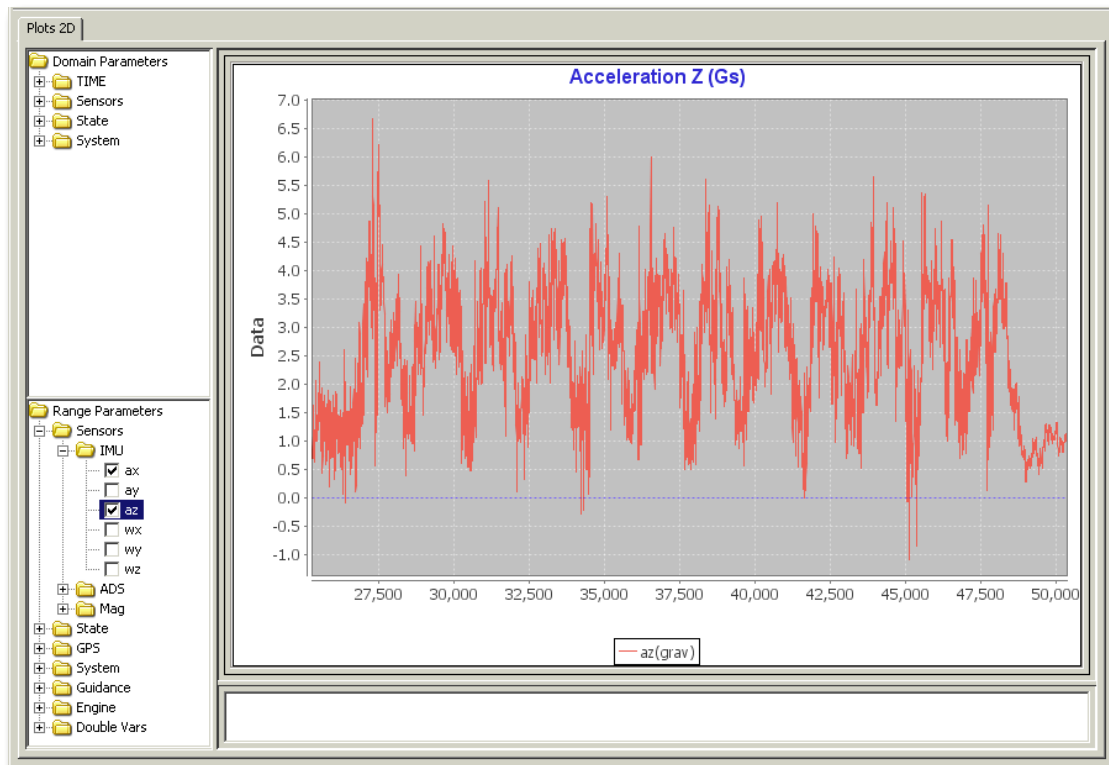


Figure 19

- There are a lot of other customizations available in the **properties** menu, on the **plot tab** the properties of both Domain and Range Axis, such as colors, ticks, font and range:

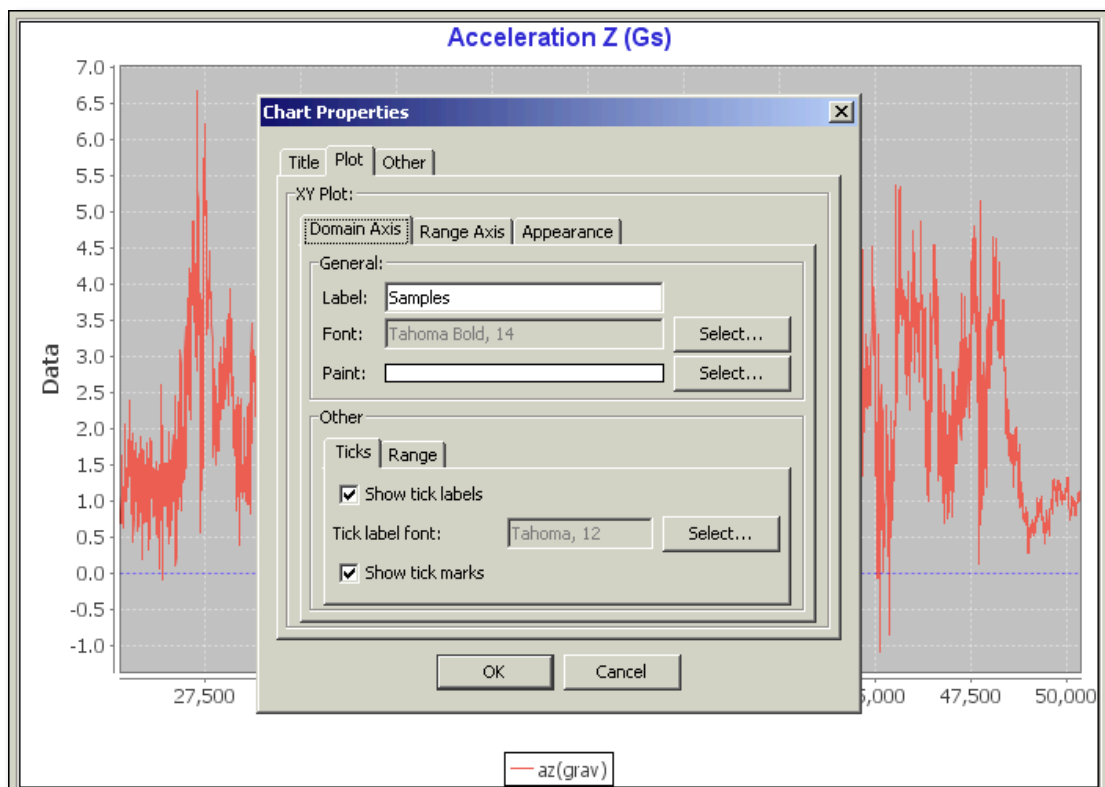


Figure 20

- In the **Appearance** tab we can customize as seen in figure 21:
  - the outline stroke with some different kinds of lines,
  - the outline and background paint
  - and the orientation of the plot (vertical or horizontal)

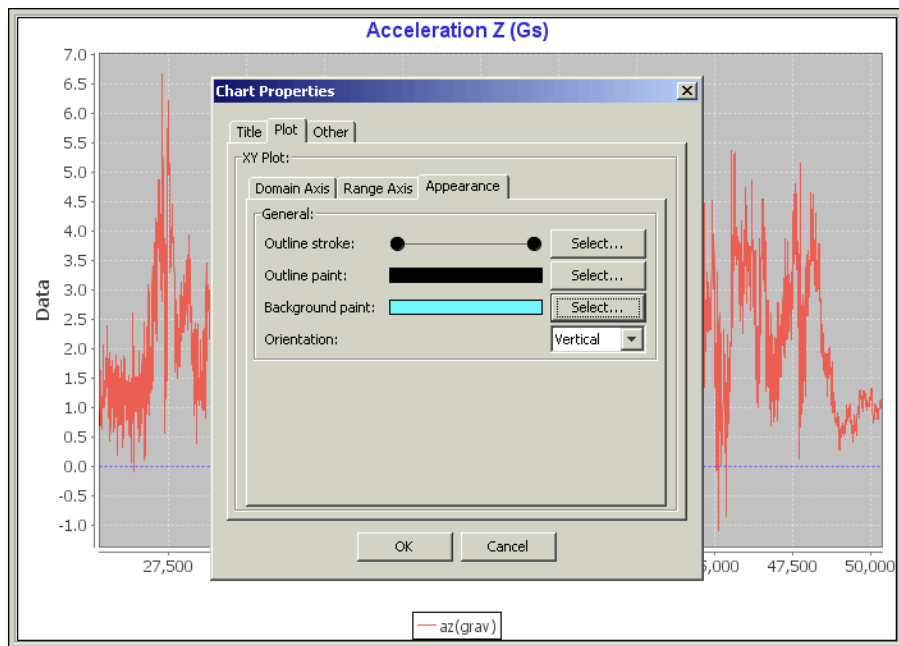


Figure 21

## 2.5. Autopilot Probes Plots

Probes are software special variables used for exceptional applications or software debugging issues. Those values can be shown in Lynx 2 in Range Parameter tree on the PROBES leaf.

The different probes in AP04s go from 0-255 but only three will be possible for selection for space reasons. To select the probe values from those 256, click on the main program menu bar-> options item -> General tab, on the lower part of the panel (as shown in figure 23 next page).

## 3. Real Time Data

### 3.1. Connection

Lynx 2 can connect to any UAV Navigation data source (all autopilots, EFIS, Visionair, or User Tools via the application player) through serial port, UDP or TCP connections.

Click on the main menu bar and click **connect to...** and a connection dialog will arise to select the connection method to the data source.

Once the connection is made Lynx 2 behaves the same way as the offline file debriefer.

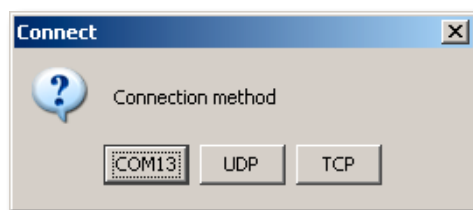


Figure 22

### 3.2. Configuration

Real-time data plot can be memory expensive, for this reason one of the application's General options tab gives the possibility to select the maximum number of samples for each plot after which the array hosting the data will not get bigger and the plot will slide leftwards.

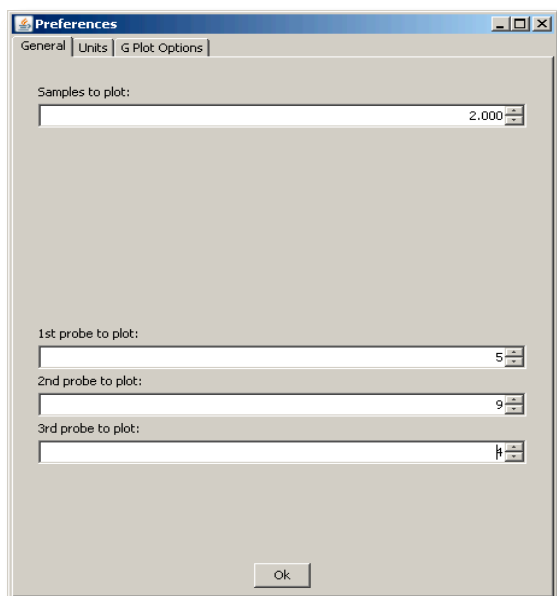


Figure 23

### 3.3. Data visualization example

A good visualization process can be achieved with some graphs showing related plots all synchronized and receiving data. For instance:

- Once connected we click the Pitch checkbox on the State->Attitude leaf of the Range Parameters tree:

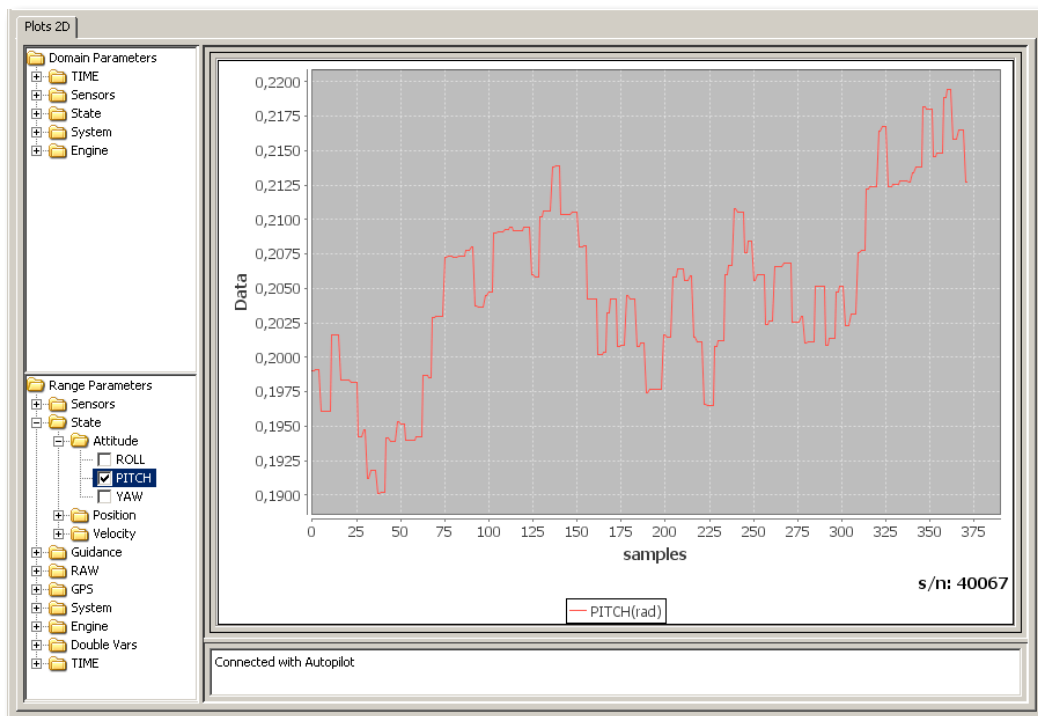


Figure 24

- Double-clicking on the pitch plot will move it out of Lynx 2, but it will keep on receiving data.
- We can then do a plot of altitudes (HBAR, GPSALT)

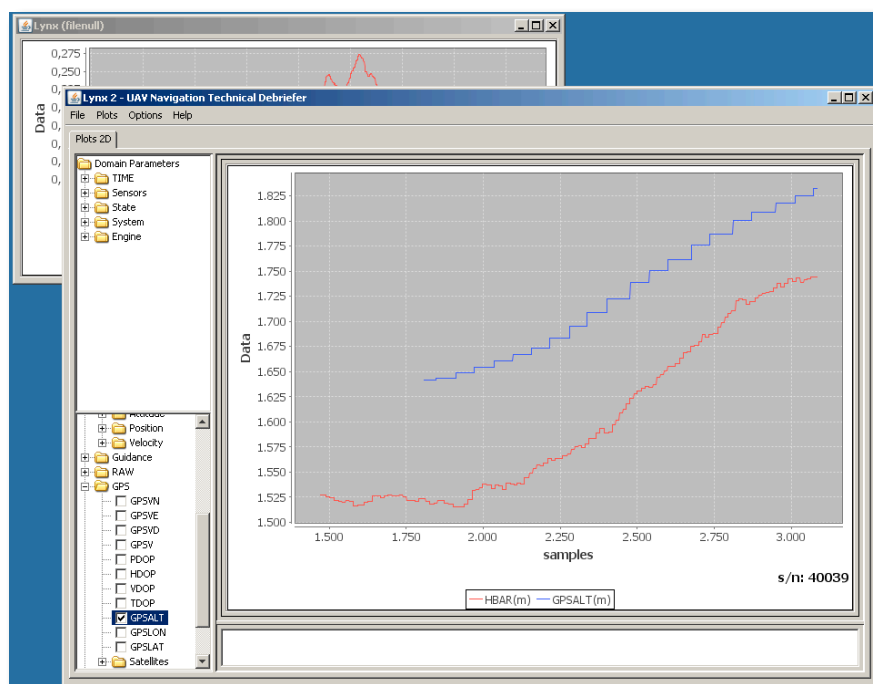


Figure 25

- And then other plots that could interest in the real-time analysis like Roll and all the accelerations

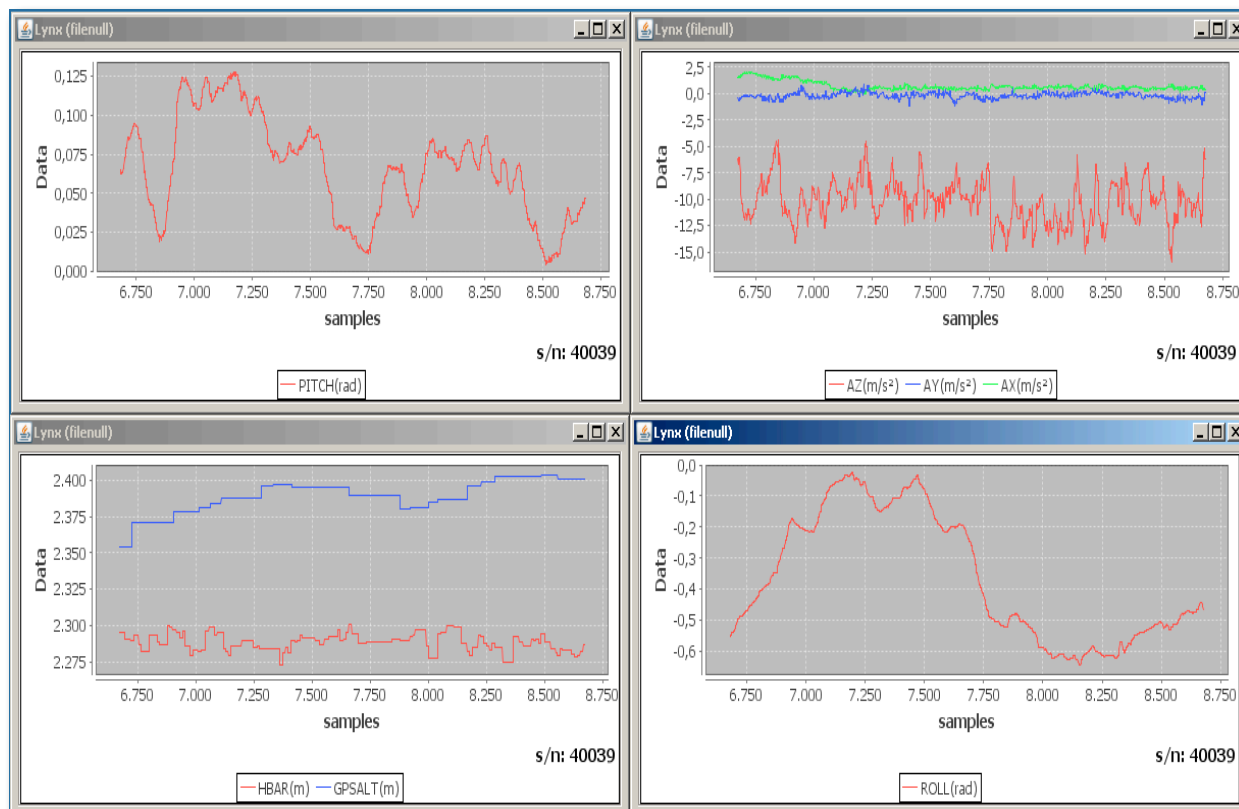


Figure 26

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### 3.4. Real time Attitude and Heading Reference System (AHRS)

When any of the family of UAV Navigation systems is connected to Lynx 2, a menu called AHRS is enabled on the Options part of the main program menu bar. This item creates an independent from Lynx 2 frame, with an standard aviation attitude and heading reference system.

This AHRS shows the Attitude, Heading, KIAS (IAS in knots), KGS (Ground Speed in Knots) and AZ (Acceleration in Z-axis in Gs), altitude (in feet), a typical aeronautic sideslip ball and mission time of the system connected to Lynx 2 as shown in figure 27.

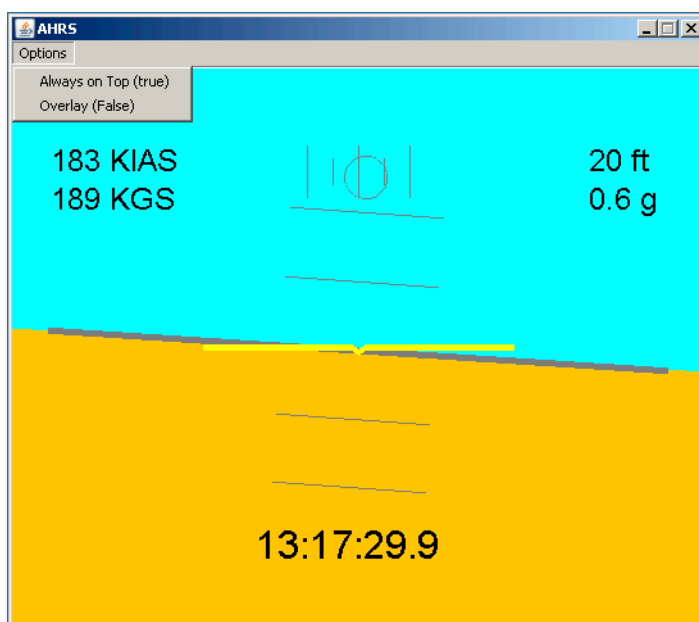


Figure 27

The “Options” menu in the AHRS frame, as seen in the figure 27 gives the possibiity to toggle the “always on top” property of this frame, making easier to handle its visibility. The other option gives the opportunity to toggle between a normal overlay AHRS like the one on figure 27 or a head up display type of AHRS as in figure 28.

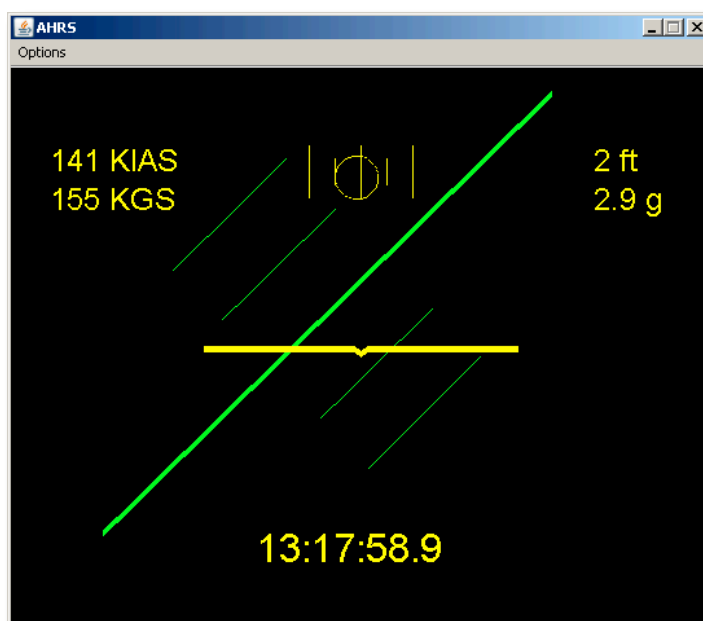


Figure 28



## 4. Special plots

### 4.1. Double Variables

On the lower part of the **Range Parameter** tree the last folder is named Double Vars. This folder holds useful two dimensional plots to add afterwards a third parameter overlayed.

- Let's plot lat & lon from a oval air race track:

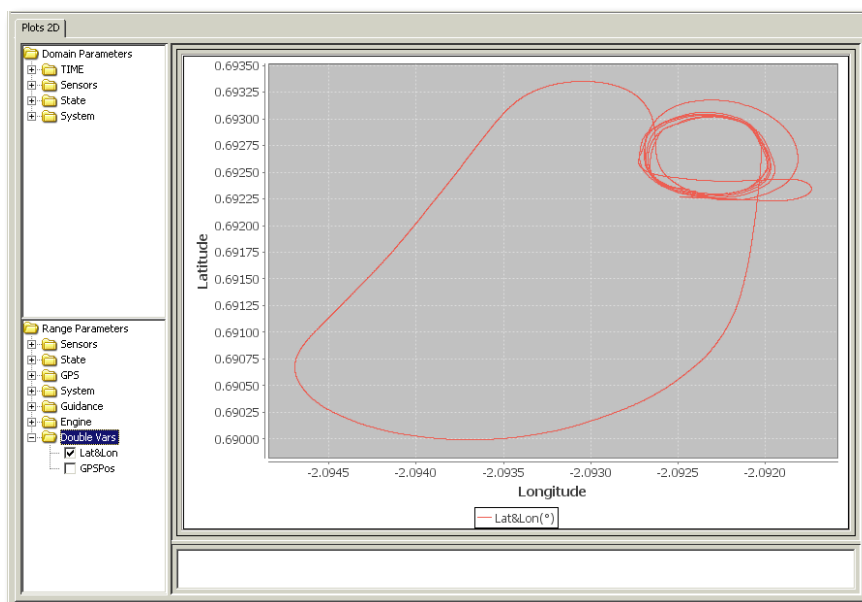


Figure 29

As shown on previous points we zoom to the track and click right button over the curve plotted, this will show the pop-up menu with the option **Add Var**, this variable will be the third parameter to plot.

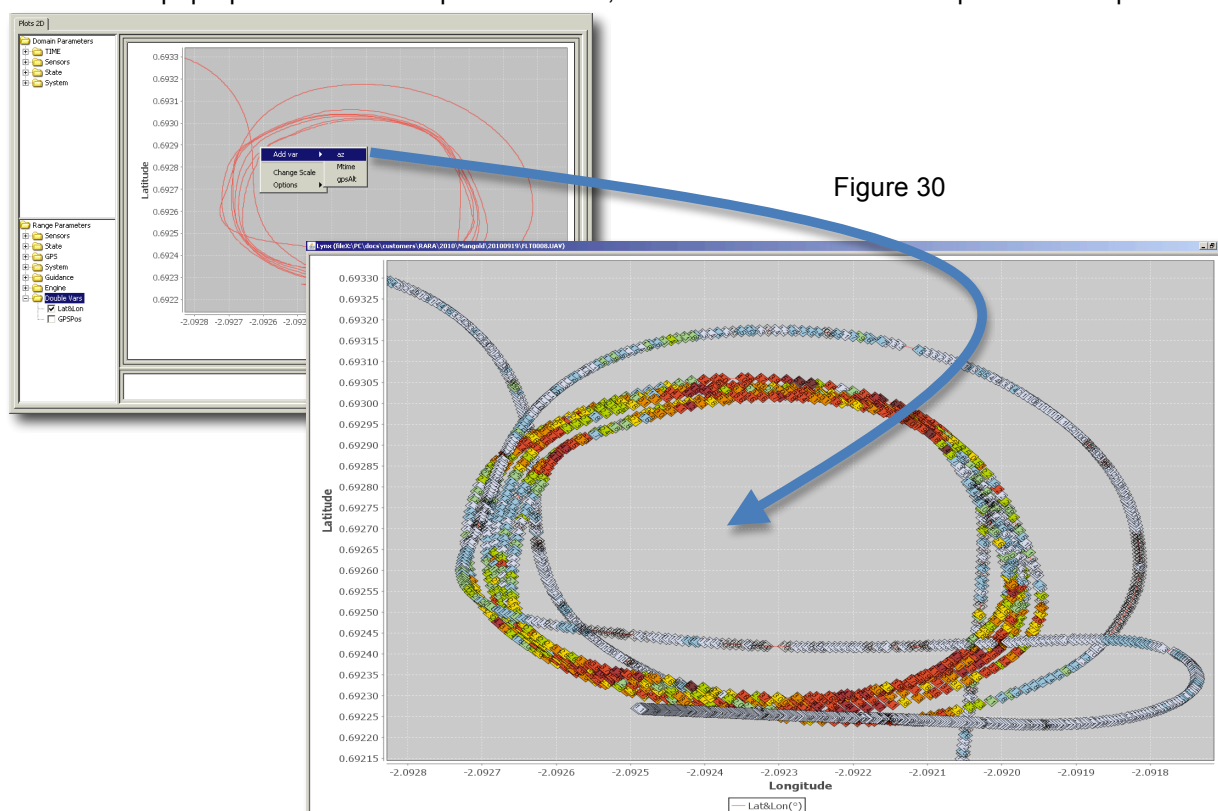


Figure 30

- The Z-axis values in G units is shown overlayed over the track, with a color coding that can be selected on the menu bar the **options item -> preferences -> G plot Options**. The dialogue shows 10 different **color boxes** with a **select button** and a **spinner**. The color on each box will be used on the overlay on those parts in which the acceleration on the Z-axis is above the level on its spinner and below the next one.

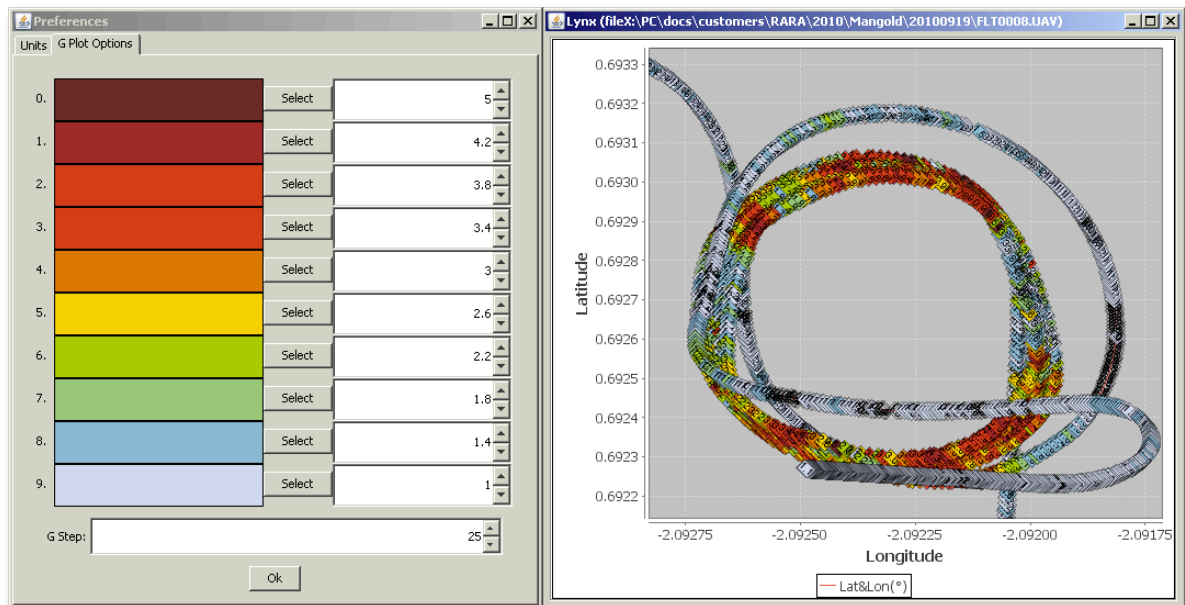


Figure 31

- There is another spinner with the text G Step wich permits us to change the step between how many samples the overlays will be shown. In this way, the higher the number, the fewer the number of overlays. In the figure 31 stands that there will be one overlay each 25 samples of log file. Figure 23 has one overlay each 200 samples, and has been zoomed in to show the curves with more detail.

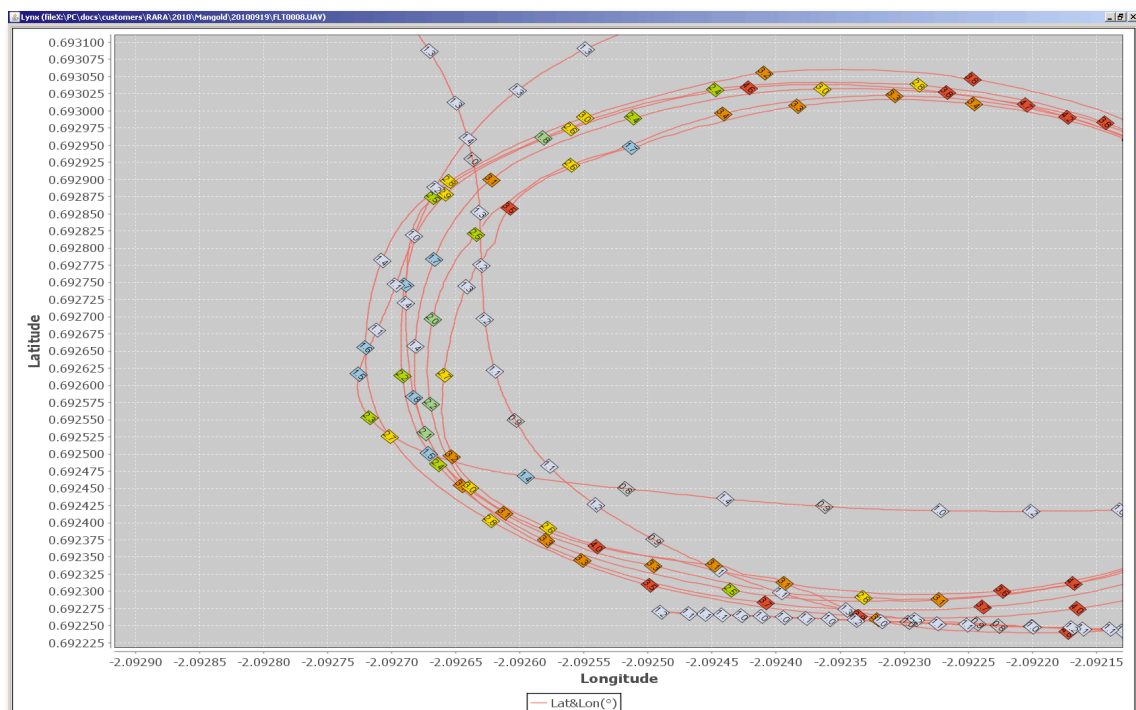


Figure 32

## 5. UTC, Total, Mission and Flight Time selection

Lynx 2 not only can plot against samples (default), it can plot against all the times used in the AP04 system and even between other crossed parameters.

One of the singularities in plots against Mission Time, is that this time can be reset to zero, thus having the possibility to have back time jumps like in figure 33:

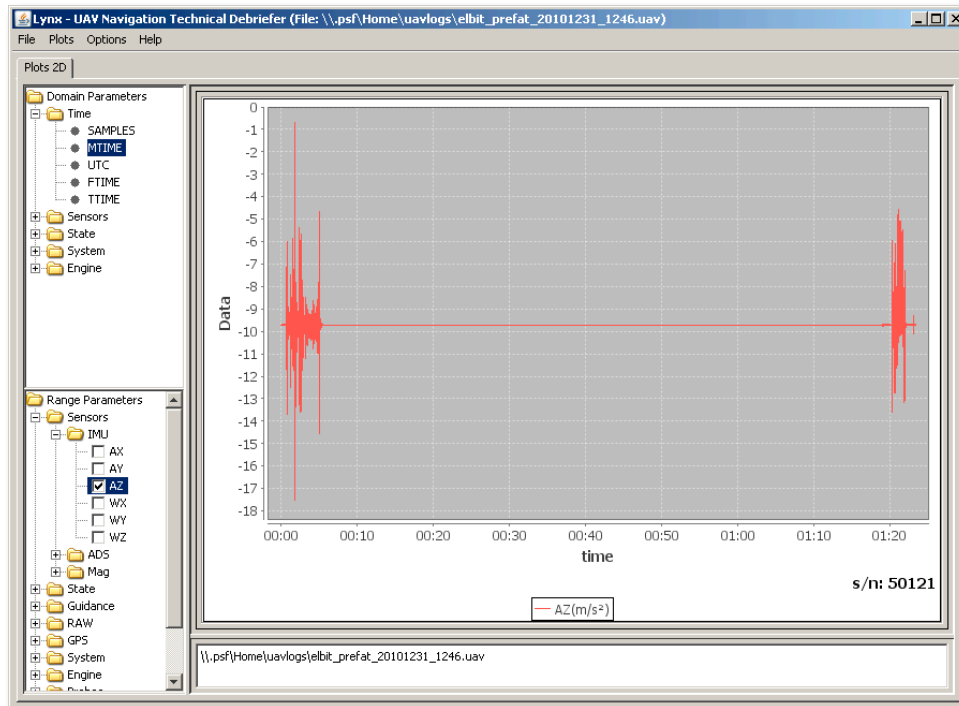


Figure 33

To search for specific parts of the log file it does not make too much sense to use the usual Lynx 2 [zooming](#) property, the proper way to zoom in this case is opening the Preferences window inside the Options main application menubar item and clicking on the Mission Time Selection tab:

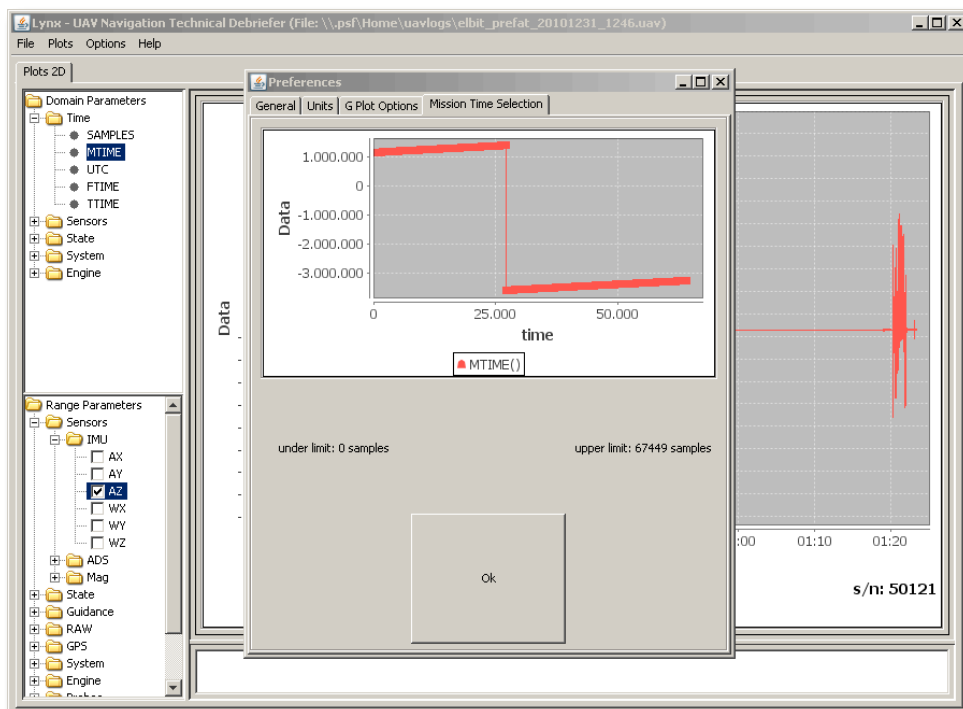


Figure 34

This tab shows a Mission Time against samples plot, and a couple of labels showing the under and upper limits selected. A selection can be made on this plot activating a change in the main plot which will show only the samples selected:

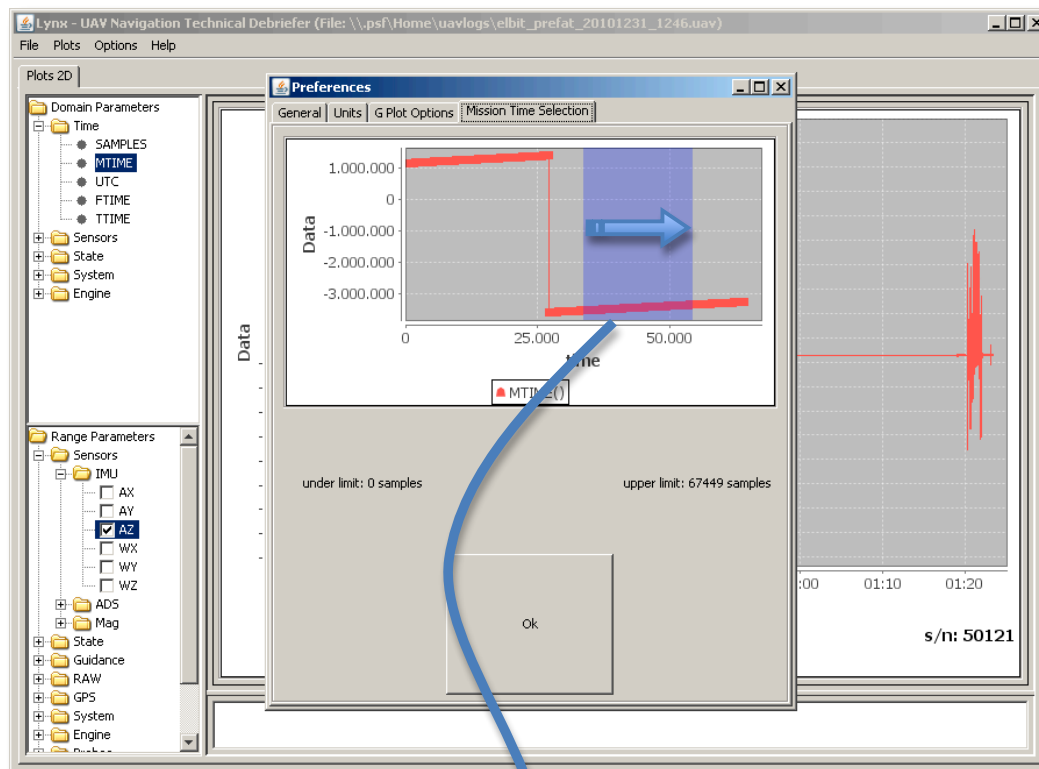
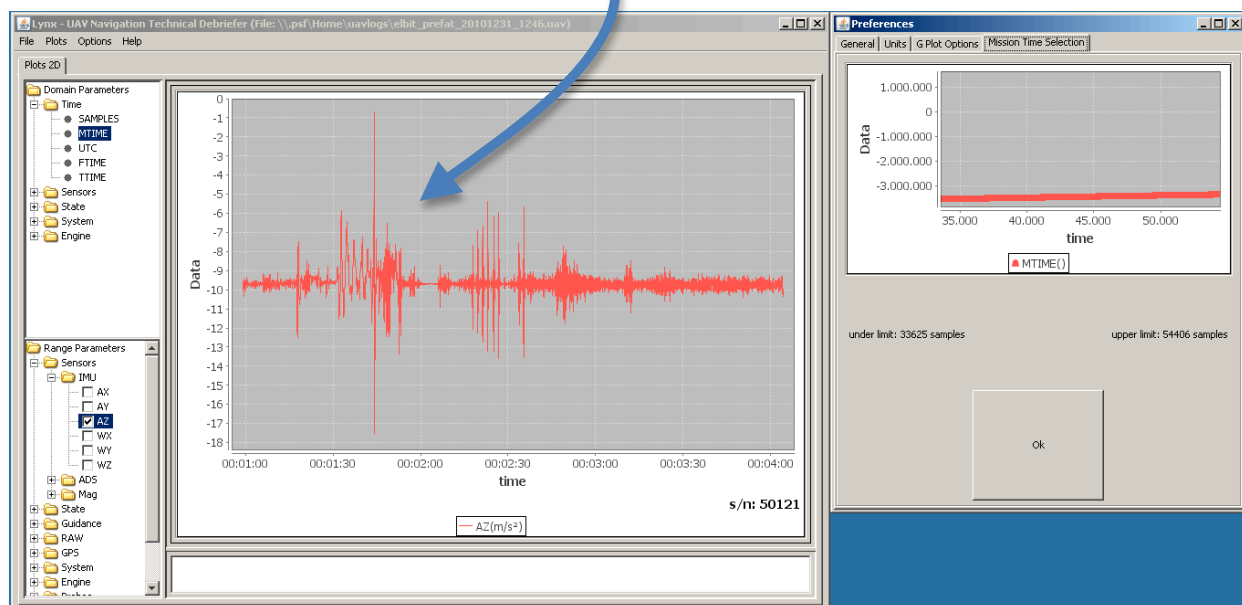


Figure 35



As we can see, now only the part of the flight selected is shown.

This way of zooming, can be used for all the other AP04 times and even with samples.

## 6. Units

Lynx has a complete set of unit tooling. All international and aeronautic units are supported, as well as other used in different communities.

All the possibilities are together under the **units dialog** found under the **menu bar -> options -> preferences -> Units tab** and looks like figure 36:

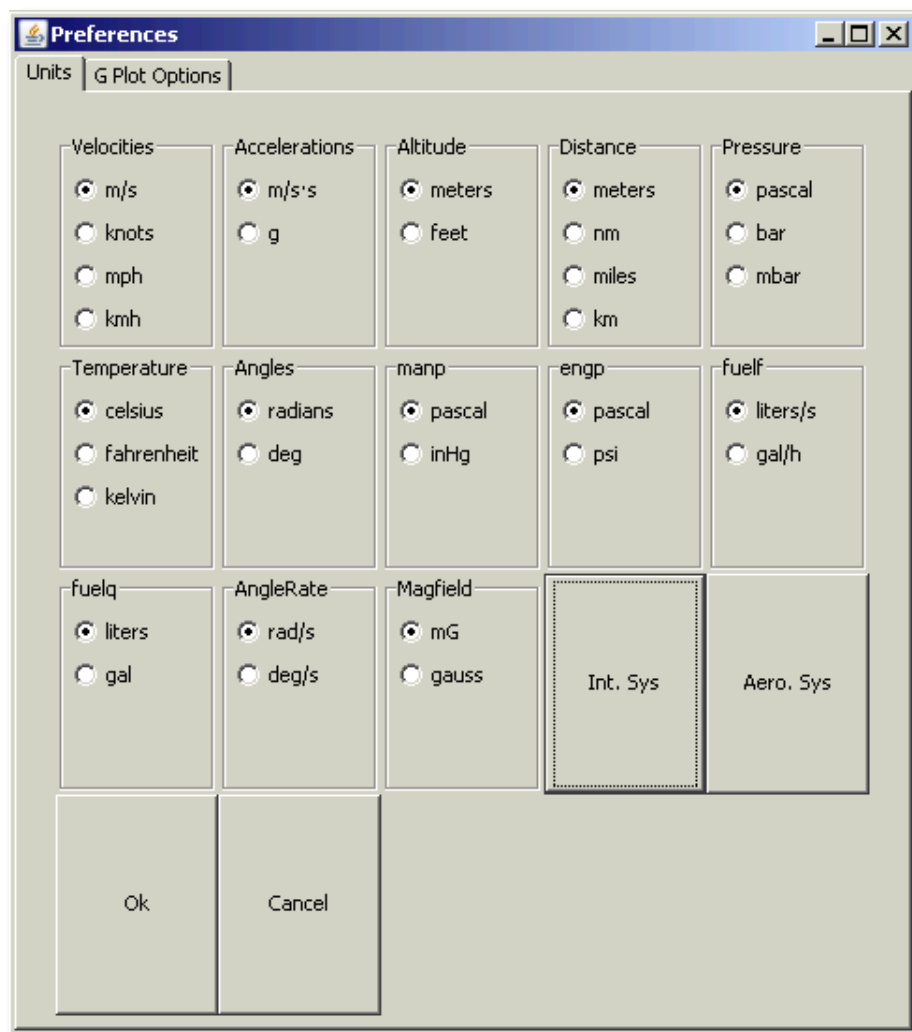


Figure 36

**Int. System** button: is a short-cut button to make the international unit system used on next plots.

**Aero. System** button: is a short-cut button to make the Classic Units used in aeronautics used on next plots.

Other than the short-cut buttons, units can be selected manually one by one, thus making possible to mix different unit systems if desired.

## 7. Alarms

Lynx alarm plots are different from the rest of the plots, as they can only show two values (thrown or not thrown) for visibility reasons those values are painted as '1s' and a '-1s' values respectively.

In the figure 28, the GPS alarm has been painted and it is easy to determine that it has been thrown seven times

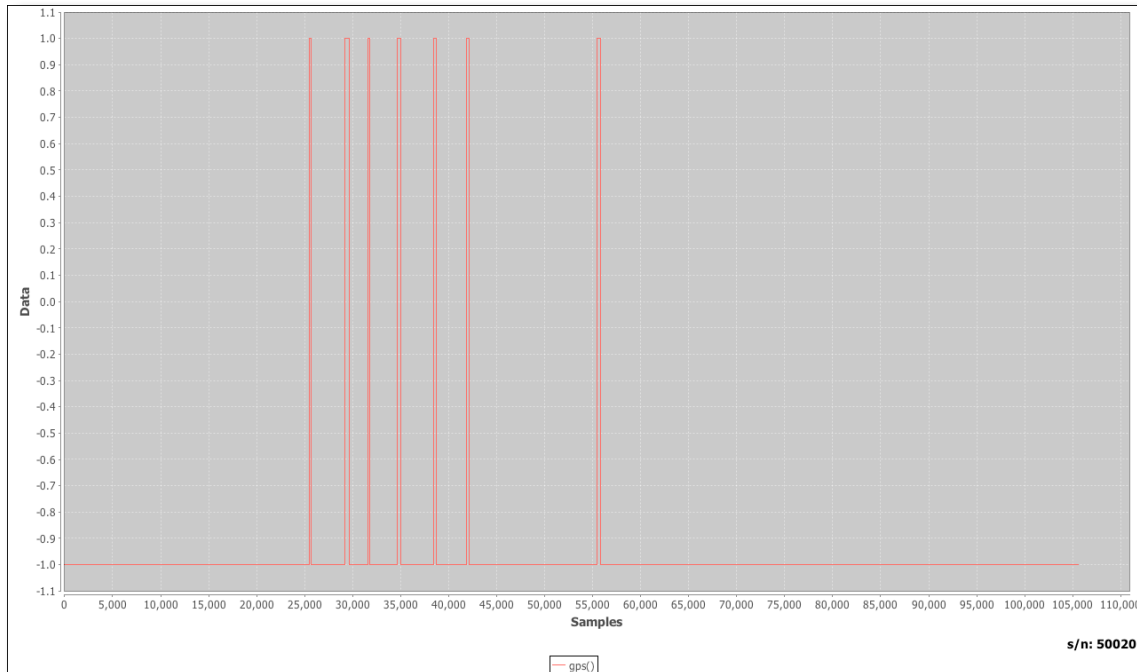


Figure 37

Only one alarm can be shown at a time (for visibility reasons too) but other variables can be plotted to compare against the actual alarm as in figure 29 where the same GPS alarm has been compared to the ROLL angle of the aircraft:

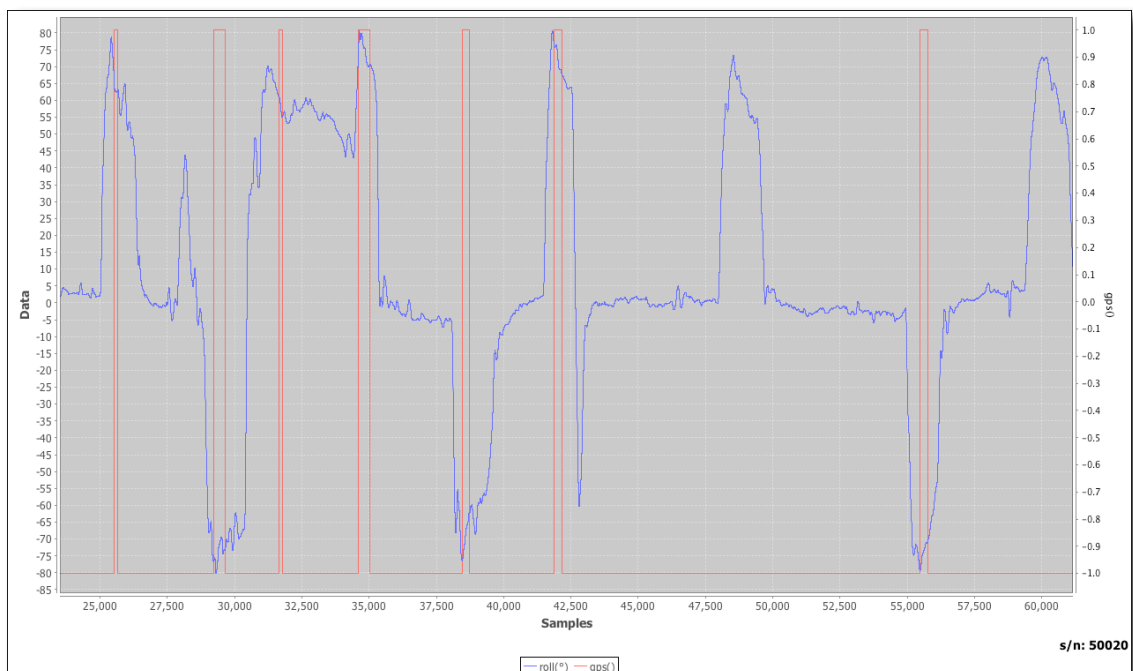


Figure 38

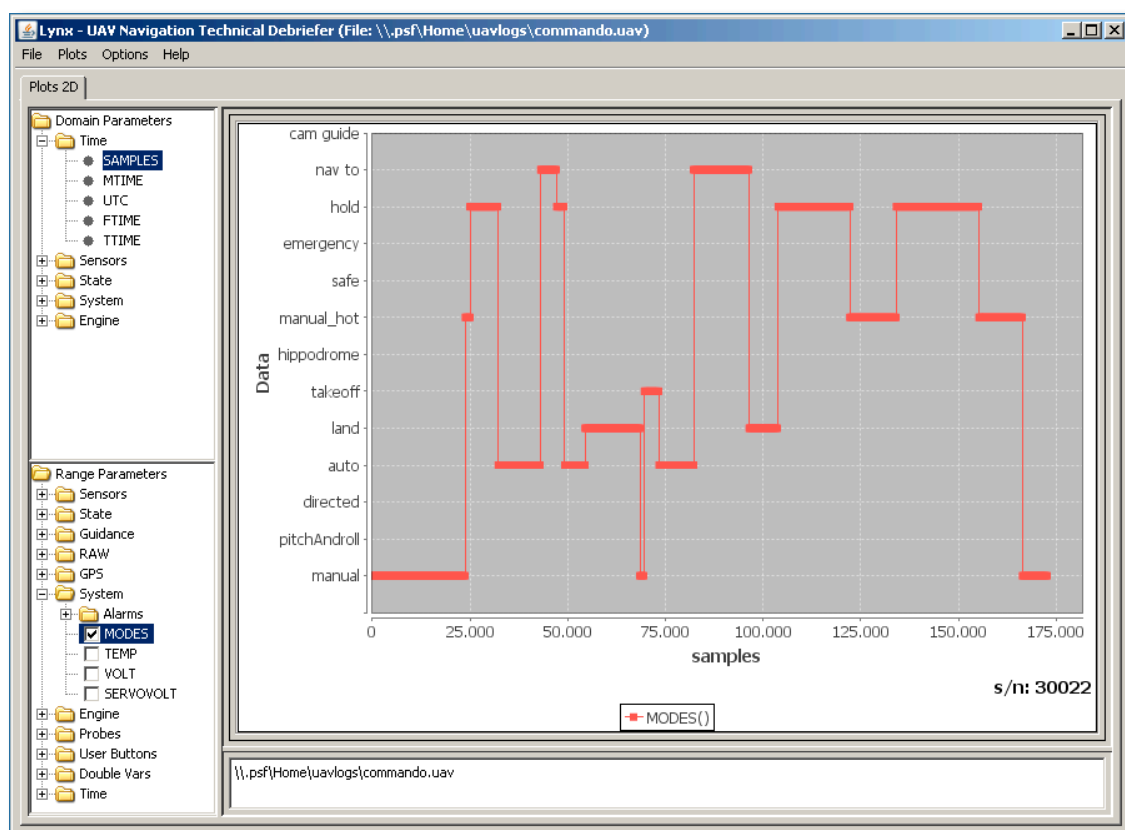
- **Alarms and meanings:**

att : "attitude out limits"  
 lul : "long uplink loss"  
 gnd: "on ground"  
 dgps: "dgps"  
 tsr: "temperature sensor failure"  
 py0: "payload on uart0 fail"  
 py1: "payload on uart0 fail"  
 ax: "forward acc. out limits"  
 eng: "engine failure"  
 utc: "utc out of sync"  
 gps: "gps no fix"  
 tmp: "temperature out range"  
 hgy: "high angular velocity"  
 v1: "system voltage out range"  
 v2: "servo voltage out range"  
 rst: "system reset"  
 acc: "accelerometers out range"  
 rg: "rate gyros out range"  
 imu: "imu out range"  
 mag: "magnetometer out range"  
 ps: "static pressure out range"  
 qd: "dynamic pressure out range"  
 agl: "agl limit exceeded"  
 sul: "short uplink loss"  
 rpm: "rpm out range"  
 g2d: "gps on 2d"  
 bng: "bingo time reached"

## 8. Autopilot Modes

When using Lynx 2 for autopilot applications, the Autopilot Modes plot is of extreme importance, since it shows, in the time line of the flight, the different modes in which the autopilot was used, thus allowing a deeper telemetry analysis.

The way to ask for this special plot is clicling on the Range Parameters-> System -> Modes leaf of the Range Parameters tree.



Figures 39

The modes are: manual, pitch and roll, directed, automatic, landing, take off, hippodrome, manual hot, safe, emergency, hold (hover) and navigate to.

All the possible modes and their meaning are explained in the AP04 User Manual.

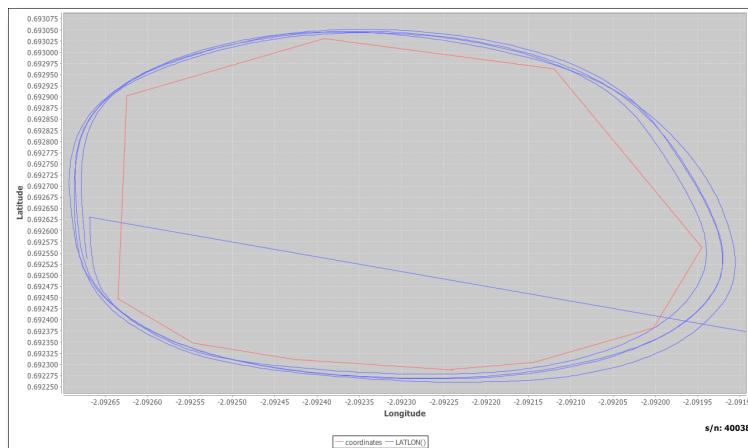
Another plot can be overlaid over the modes plot but will change the left scale, then the way to analyze in an easy way is to change the scale of the new plot as explained in [Change Scale](#)



## 9. Export data to Google Earth

Lynx 2 gives the opportunity to create ready-to-import files for the freeware application Google Earth, those files are extended with .kml word and with a double-click are automatically executed overlaying the trajectory of the flight studied, thus giving a much more realistic and easy to handle vision of the flight than the 2 dimensional lat-lon plots, as shown in figures 34.

The kml file can be created once the UAV file has been loaded enabling the Export to Google Earth... menu item on the file tab of the main menu bar. The file will be named as the source UAV file, and it will be created under the same folder.



Figures 40



## 10. FAQs:

### Why does Lynx freezes when many plots are painted?

JVM uses as a default 1 Mb of heap space, clearly not enough for many applications (one amongst them Lynx). If a heavy log file is used, the recommended action is to create a batch file (.bat in windows or .sh in MacOS X) altering the JVM arguments with the commands:

```
java -Xmn100M -Xms500M -Xmx500M -cp Lynx.jar lynx.Main
```

This way Lynx will be launched with 500Mb of heap space and 100Mb of new generation class space, thus allowing space enough.

### Is there any easy and fast way to change to a more contrasted colors?

Yes, Lynx 2 has three different **themes**, **gray** (the one used on this manual), **legacy** and **dark**.

Dark theme has much more contrast and can be selected easily on the application menu bar **options -> theme -> dark** and creates charts as the one on figure 41:

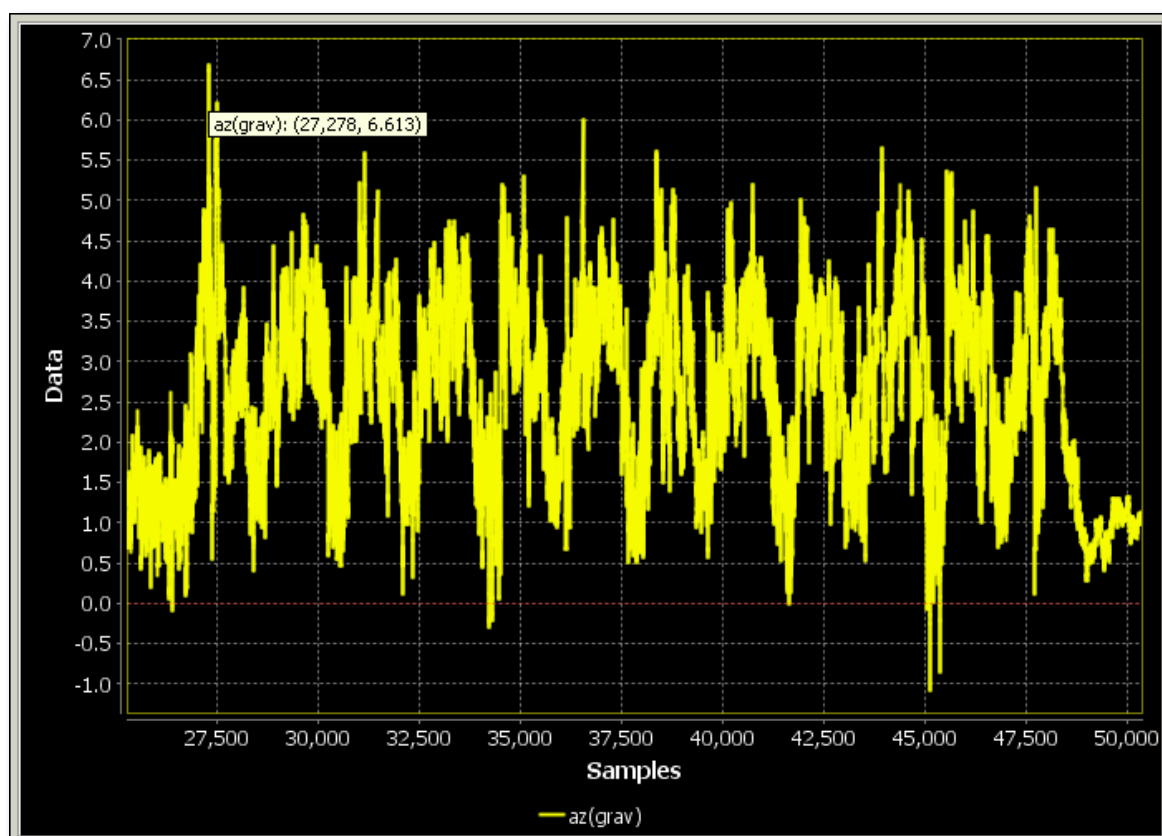


Figure 41